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ABSTRACT

This training unit on sprinklers, standpipes, and detection systems is part of a 17-unit course package written to aid instructors in the development, teaching, and evaluation of fire fighters in the Wisconsin Fire Service Certification Series. The purpose stated for the 6-hour unit is to provide the fire fighter with an understanding of the various types of protection and detection systems. An instructor's guide sheet provides this information: introduction to the topic, instructor preparation, length of unit, methods of instruction, testing, equipment and facilities required, recommended visual aids, and references. Following a list of unit objectives, a lesson plan outlines the main teaching points and states the preferred teaching method, cites the reference and page number(s) where the information is to be found, and indicates the necessary handouts. Other contents in the unit include a unit quiz, answer key to the quiz, and handouts (graphs, student worksheets, informational material, and forms). (YLB)

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FIRE SERVICE CERTIFICATION SERIES

UNIT FSCS-FF-11-80

SPRINKLERS/STANDPIPES/DETECTION SYSTEMS

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SPRINKLERS/STANDPIPES/DETECTION SYSTEMS

Prepared by:

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Fire Service Training

INTRODUCTION

This unit is designed to provide the fire fighters with a understanding of the various types of fire protection and detection systems. These systems are made up of equipment and devices which have been installed or located within or about the property of the owner to deal with the outbreak of fires. The purpose of these fire protection and detection systems is to provide a means by which fires may be prevented or attacked in their incipient phase and/or controlled until public fire protection can arrive. There are many types of systems and they will be covered in this unit.

INSTRUCTOR PREPARATION

Carefully study the objectives to determine the goals that have been set for the firefighters upon completion of the unit.

Review the lesson plans and if necessary, consult the references listed.

Develop suitable audio-visual aids, provide training area and necessary tools and equipment to effectively teach this unit.

LENGTH OF UNIT

Classroom	4 hours
Practice	1 hour and 30 minutes
Evaluation and Testing	30 minutes

METHOD OF INSTRUCTION

Lecture-Illustration and Demonstration Methods

Suggested methods and techniques are listed under Instructors Notes on the lesson plan. For further information consult Fire Service Instructor Training, IFSTA #303 3rd ed., pp. 71-83.

TESTING

At the end of this unit a written quiz of five or more questions will be given.

EQUIPMENT AND FACILITIES REQUIRED

Classroom with necessary audio-visual and demonstration equipment

1. Hose
2. Pumper equipped with necessary equipment
3. Standpipe and sprinkler systems w/connections

RECOMMENDED VISUAL AIDS FOR THIS UNIT

Unit 5 - Automatic Fire Protection Systems & Devices Sections 1-2 and 3
Unit 14 - Standpipe systems & Operations
Unit 22- Fire Detection Devices
Unit 23 - Special Hazard Fire Protection Systems
R.J. Brady Company, Washington, D.C.
IF-SPR Sprinkler - IFSTA, Stillwater Oklahoma

REFERENCES

Hudiburg, E. and McCoy, C. Ed., Water Supplies for Fire Protection, 2nd ed., #205 IFSTA, Stillwater, 1971 pp. 103-105

Hudiburg, E. Ed., Fire Department Support of Automatic Sprinkler Systems, 1st ed., #204, IFSTA, Stillwater, 1966, pp. 3-75

Hudiburg, E. and Thomas, C., Ed., Fire Hose Practices, 6th ed., #103, IFSTA, Stillwater, 1974, pp. 120-123

Lauhlin, J.W., Ed., Private Fire Protection and Detection, 1st ed., #210, IFSTA Stillwater, 1979 pp. pp. 1-56, pp. 103-114, pp. 59-102, pp. 140-152

OBJECTIVES

All objectives in this unit are to be met according to the material contained in the International Fire Service Training Association Manuals #205 Water Supplies for Fire Protection, #204 Fire Department Support of Automatic Sprinkler Systems, #103 Hose Practices and #210 Private Fire Protection and Detection.

To staisfactorily complete this unit, the firefighter must attain a grade of 70 or higher on the written quiz and sucessfully complete the practical skills examination.

NFPA STANDARD 1001

SPRINKLERS

FIRE FIGHTER I

3-13 SPRINKLERS

3-13.1 The firefighter shall identify the fire department sprinkler connection and water motor alarm.

3-13.2 The firefighter shall connect hose line(s) to a fire department connection of an automatic sprinkler system.

3-13.3 The firefighter, when given a sprinkler head in servicable use, shall demonstrate knowledge of how the automatic sprinkler head opens and releases water.

3-13.4 The firefighter, when given the necessary equipment, shall effect a temporary stop of the flow of water from a sprinkler head.

FIRE FIGHTER II

4-14 SPRINKLERS

4-14.1 The firefighter shall identify the main drain valve on an automatic sprinkler system.

4-14.2 The firefighter shall open and close a main drain valve on an automatic sprinkler system.

OBJECTIVES

FIRE FIGHTER II

4-14 SPRINKLERS

4-14.3 The firefighter shall identify the main control valve on an automatic sprinkler system.

4-14.4 The firefighter shall operate a main control valve on a automatic sprinkler system from "open" to "closed" and then back to "open".

4-14.5 The firefighter shall demonstrate knowledge of the automatic sprinkler in providing safety to life of occupants in a structure.

4-14.6 The firefighter shall identify and explain the dangers of premature closure of sprinkler main control valve, and of using fire hydrants to supply fire hose streams when the same water system is supplying the automatic sprinkler system.

4-14.7 The firefighter shall identify the difference between an automatic sprinkler system that affords complete coverage and a partial sprinkler system.

4-14.8 The firefighter shall identify at least three sources of water for supply to an automatic sprinkler system.

4-14.9 The firefighter shall identify the following: (a) Wet sprinkler system; (b) Dry sprinkler system; (c) Deluge sprinkler system.

4-14.10 The firefighter, when given the tools and sprinkler head, shall properly remove one head from the system and replace it with a head of the same type.

COURSE: FIRE SERVICE CERTIFICATION SERIES

LESSON: SPRINKLERS/STANDPIPES/DETECTION SYSTEMS

EQUIPMENT NEEDED: SLIDE, OVERHEAD OR MOVIE PROJECTOR, SCREEN

TRAINING AIDS: TRANSPARENCIES, SLIDES, FILMS, TEXTS

INSTRUCTORS NOTES	TEACHING POINTS
Ref: Private Fire Protection and Detection, IFSTA #210 p. 8	I. AUTOMATIC SPRINKLER SYSTEMS Early types of sprinkler systems were rather crude and unreliable, but present-day systems have been perfected to the point that they are extremely reliable when properly maintained. The reduction of insurance rates for property that is equipped with sprinkler protection has been a very influential factor in the growth of the number of installations in properties. The automatic sprinkler heads and all component parts of the systems should be listed by a nationally recognized testing laboratory, such as Underwriters Laboratories or Factory Mutual. Automatic sprinkler systems are now recognized as the most reliable of all fire protection devices and an understanding of the system of pipes and valves and their operation is essential to the firefighter. Automatic sprinkler protection consists of a series of devices so arranged that the system will automatically distribute sufficient quantities of water to either extinguish a fire or to hold it in check until firefighters arrive. Water is supplied to the sprinkler heads through a system of piping. the sprinkler heads can either extend from exposed pipes or protrude through the ceilings or walls from hidden pipes.
Spacing of sprinklers according to occupancy Light Hazard - 15 feet between heads. Ordinary Hazard - 15 feet between heads. Extra Hazard - 12 feet between heads.	The process of spacing sprinkler heads in a building must conform to well established and tested standards, such as NFPA Standard No. 13, INSTALLATION OF SPRINKLER SYSTEMS. Standards are also set for the size of pipe to be used, the proper method of hanging the pipe and all other details concerning the installation of a sprinkler system. The design of automatic sprinkler systems is based upon the assumption that only a portion of the sprinkler heads will be opened during a fire. Most ordinary public waterworks systems could not be expected to adequately supply 500 or 1,000 operating sprinklers. This statement emphasizes the fact that a sprinkler system must be properly designed and

INSTRUCTORS NOTES

TEACHING POINTS

5-9 SPRINKLERS

5-9.9

I. AUTOMATIC SPRINKLER SYSTEMS

an adequate source of water must be provided. Water volume and pressure must be adequate for the number of sprinkler heads that are calculated to operate at one time in any given building.

NOTE:

Ref: p. 9

About 96 per cent of all fires in sprinklered buildings are either extinguished by sprinklers or held in check until they are completely extinguished by firefighters.

35 percent of the remaining 4 per cent of fires that were not controlled by the sprinkler system was due to

CLOSED SYSTEM VALVES

or

CLOSING SPRINKLER CONTROL VALVES BEFORE COMPLETE EXTINGUISHMENT

65 per cent of the remaining 4 per cent of fires that were not controlled by the sprinkler system was due to varied reasons, most of which could have been corrected:

POOR OR IMPROPER MAINTENANCE
IMPROPER DESIGN
HAZARDS OF OCCUPANCY
DISTRIBUTION OBSTRUCTIONS
DEFICIENT WATER SUPPLIES
ONLY PARTIAL SPRINKLER PROTECTION

Another interesting feature of sprinklered buildings is that 35 per cent of the fires that were controlled by sprinkler operations were controlled by the operation of only one sprinkler head..

Ref: P. 10

A sprinkler system piping layout consists of different size pipe.

The system starts with:

A feeder main into the sprinkler valve
A vertical pipe from the valve supplying the system and containing a check valve called the RISER
The pipes connecting the RISERS to the CROSS-MAINS are known as FEED MAINS

INSTRUCTORS NOTES	TEACHING POINTS
Ref: Private Fire Protection and Detection, IFSTA, #210 p.10	Sprinkler system cont. The CROSS-MAIN directly services a number of BRANCH LINES on which the sprinklers are installed. CROSS-MAINS extend past the last BRANCH LINES and are capped to facilitate flushing. The entire system is supported by hangers and clamps. All pipes in a DRY SYSTEM are pitched to help drain the system back toward the main drain.
Ref. pp. 10-16 5-9 SPRINKLERS 5-9.2	SPRINKLER HEADS Automatic sprinklers often called "sprinkler heads" or just "heads," discharge water after the release of a cap or plug which is activated by some heat responsive element. This head may be thought of as a fixed-spray nozzle that is operated individually by a thermal detector. There are numerous types and designs of sprinkler heads. Only the most common will be covered in this unit.
Ref. p. 11 5-9 SPRINKLERS 5-9.2	Installed heads in WET and DRY-PIPE SYSTEMS are kept in a closed position by various devices. Three of the most commonly used release mechanisms are: 1. fusible links 2. glass bulbs 3. chemical pellets all of which fuse or open in response to heat.
3-13 Sprinklers 3-13.3	CONSTRUCTION-OPERATION The major parts of a head are: 1. fusible link, glass bulb or chemical pellet 2. lever arm 3. valve cap 4. toggle joint 5. frame arms 6. deflector

INSTRUCTORS NOTES

TEACHING POINTS

Ref: Private Fire Protection and Detection, IFSTA, #210 p. 10-16

3-13 Sprinklers

3-13.3

Refer to Handout #2

5-9 SPRINKLERS

5-9.2

CONSTRUCTION-OPERATION

In the fusible link type of head the following actions take place to permit the waterflow:

1. The solder melts in the fusible link at a predetermined temperature,
2. The lever arms are released and spring clear of the head,
3. As the lever arms pop out, the seated valve cap is released, which permits the water to flow.

The standard orfice over which the cap is held is one half inch in diameter.

A deflector is attached to the sprinkler frame and discharge water is directed against this to convert it into a spray.

TYPES

STANDARD SPRINKLERS HEADS are designed to discharge a spray of water downward in a hemispherical pattern.

These UP-RIGHT TYPE of standard sprinkler heads cannot be inverted for use in the hanging or pendant position because in the inverted position the spray of water would be directed toward the ceiling due to the design of the deflector.

PENDANT-TYPE sprinklers should be used in locations where it is impractical to use sprinklers in an upright position.

The VERTICAL SIDEWALL sprinkler is mounted close to the wall and the specially designed defletor directs a water spray away from the wall. used to protect small rooms, hallways, atriums and vertical openings.

A DIRECTIONAL HEAD sprinkler is used in special areas for spray direction.

DECOR HEADS are used in areas where appearance is a concern.

The QUICK-RESPONSE type of head is used where reaction time is critical. Heat collects in the bell-shaped heat collector and activates the head in a shorter time.

INSTRUCTORS NOTES	TEACHING POINTS
Ref: Private Fire Protection and Detection, IFSTA, #210 pp. 10-16	TYPES
	SPECIAL HEADS are desined for installation inside storage racks. The large deflector or shield on these heads prevents water discharging from overhead sprinklers form cooling the lower heads and delaying activation.
Ref. pp. 13-14	OPEN NOZZLE HEADS are used in high hazard areas where a large amount of water is needed quickly.
	COATED SPRINKLERS are used where the atmosphere could deter the operation of the head.
	OPEN DELUGE HEADS, orfice size and deflector angle can be changed based upon need.
	QUICK RESPONSE ACTUATORS can be attached to heads using utectic solder in the fusible link. The actuator sends hot gases directly on the solder link reducing the activation time.
	AN AUTOMATIC SHUT-OFF TYPE head is used where there is a concern about excessive water damage. The water is turned on and off automatically.
	STANDARD SPRINKLER HEADS may be substituted for OLD STYLE HEADS in an existing system when it becomes necessary to change a head or to upgrade the protection provided.
Refer to Handout #4	OLD STYLE HEADS should not be used to replace standard heads because the old-style heads are equipped with deflectors which direct a large percentage of the discharge to a circular area of the ceiling above the sprinkler with the remainder of the discharge being directed downward in a roughly conical pattern..(Refer to Handout #4
	The primary objection to the old-style heads is that the water falls in large drops from the ceiling.
	STANDARD SPRINKLER HEADS provide for better distribution of the water in the form of a dense fog or fine spray.
	Sprinkler heads may have a cage installed for protection against mechanical injury.
	All sprinkler heads are stamped indicating:
	1. temperature rating
	2. date of manufacture.
	3. name of manufacturer
	4. position head is to be installed

INSTRUCTORS NOTES

TEACHING POINTS

Ref: Private Fire Protection and Detection, IFSTA #210 pp. 10-16

TYPES

SPECIAL-TYPE sprinkler heads with corrosive-resistant coatings are available and should be installed in areas where chemical, moisture or other corrosive vapors exist.

Without this special coating, the operational parts of the head will corrode and may become inoperative in a very short time.

A storage cabinet should be installed in the area protected by the sprinkler system to house extra heads and a sprinkler head wrench. Normally these cabinets hold a minimum of six heads for small systems.

IMPORTANT: It is necessary to use a sprinkler wrench and to be careful when changing heads to prevent damage.

SPRINKLER TEMPERATURE RATINGS

Ref. p. 15

The sprinkler head used for a given application should be based on:

5-9 SPRINKLERS

the maximum temperature expected at the level of the sprinkler under normal conditions

5-9.2

and

the anticipated rate of heat release that would be produced by a fire in the particular area.

The temperature rating shall be indicated by color coding the frame arms of the except for;

coated sprinklers

and

decorative heads

Coated sprinklers have;

colored frame arms

coating material

or

use a colored dot on top of the deflector

INSTRUCTORS NOTES

TEACHING POINTS

Ref: Private Fire Protection and Detection, IFSTA #210 pp. 10-16

Ref. p. 15

Refer to Handout #5

5-9 SPRINKLERS

5-9.2

SPRINKLER TEMPERATURE RATINGS

Decorative sprinklers such as plated or ceiling sprinklers are not required to be color coded; however some manufacturers use a dot on top of the deflector.

TEMPERATURE RATINGS DEGREES F.	TEMPERATURE CLASSIFICATION	FRAME COLOR
135 - 170	Ordinary	Unpainted (or partly black or chrome)
175 - 225	Intermediate	White*
250 - 300	High	Blue
325 - 375	Extra High	Red
400 - 475	Very Extra High	Green
500 - 575	Ultra High	Orange

* The 135 degree sprinklers of some manufacturers are half black and half painted. The 175 degree sprinklers of these same manufacturers are yellow.

CONTROL AND OPERATING VALVES

Ref. p. 16

4-14 Sprinklers

4-14.1
4-14.2
4-14.3
4-14.4

Every sprinkler system is equipped with a main control valve and various test and drain valves.

Control valves are used to cut off the water supply to the system when heads must be replaced, when maintenance is performed or when operation must be interrupted.

They are:

a. located between the source of water supply and the sprinkler system

b. an "indicating type" and are manually operated

c. Usually located immediately under the sprinkler alarm valve, the dry-pipe or deluge valve or outside the building near the sprinkler system that it controls.

Separate control valves are required for each system.

Each Valve should be secured in the OPEN position or supervised..

INSTRUCTORS NOTES	TEACHING POINTS
Ref: Private Fire Protection and Detection, IFSTA, #210 pp. 16-55	CONTROL AND OPERATING VALVES
Ref: pp. 16-17	Water supply control valves for sprinkler systems may be: 1. Indicating Gate Valves or 2. Indicating Butterfly Valves
	The mechanism consists of a close-tolerance gate that slides or turns across the waterway in the water main.
	There are three common types of INDICATOR CONTROL VALVES used in sprinkler systems:
Refer to Fig. 1 Handout #6	1. OUTSIDE SCREW AND YOKE VALVE (OS&Y) This valve has a yoke on the outside with a threaded stem which controls the opening and closing of the gate. VALVE OPEN - The threaded portion of the stem is out of the yoke VALVE CLOSED - The threaded portion of the stem is inside the yoke
EMPHASIZE THE IMPORTANCE OF THE FIRE INSPECTOR OR COMPANY INSPECTORS MAKING SURE THESE VALVES ARE IN THE "OPEN" POSITION AT ALL TIMES. REPORT CLOSED VALVES IMMEDIAMTELY.	2. POST INDICATOR VALVE (PIV) The PIV is a hollow metal post that is attached to the valve housing. The valve stem is inside of this post; on the stem is a movable target on which the words "OPEN" and "SHUT" are printed.
Refer to Fig. 2 Handout #6	The operating handle is fastened and normally sealed or locked to the post. When the valve is closed, the word "SHUT" appears at the opening. The PIV should be locked or sealed in the "OPEN" position for normal operation of system.
	3. WALL POST INDICATOR VALVE (WPIV) WPVI is similar to the PIV except that it extends through the wall with the target and operating nut on the outside of the building. The WPIV should be locked or sealed in the "OPEN" position for normal operation of the system.

INSTRUCTORS NOTES

TEACHING POINTS

Ref: Private Fire Protection and Detection, IFSTA, #210 pp. 16-55

Refer to Fig. 3 Handout #6

Ref: p. 18

5-9 SPRINKLERS

5-9.6

POST INDICATOR VALVE ASSEMBLY (PIVA)

The PIVA is similar to the PIV except that the valve used is a "butterfly type" while the PIV and the WPIV use a gate valve.

OPERATING VALVES

GLOBE VALVES - nonindicating manually operated used for draining purposes and for test valves.

STOP OR COCK VALVES - nonindicating manually operated used for draining and for alarm silencing.

CHECK VALVES - used to limit the waterflow to one direction.

Check valves usually have an arrow printed on them to indicate the direction of water flow.

If no arrow or indication of flow direction is identifiable on the exterior of the valve, a pivot casting should be on the end toward the fire department connection.

If the arrow is pointing toward the fire department connection or the pivot casting is on the sprinkler riser side, the check valve is improperly installed.

Water pouring FROM a fire department connection indicates the check valve is not seated properly. This can be caused by a bad rubber seat, obstructions or a sticking clapper. In any case, maintenance or replacement of the check valve is indicated. Automatic drain valves serve to automatically drain piping when pressure is relieved from the valve.

The ALARM TEST VALVE - is located on a pipe which connects the supply side of the alarm check valve to the retard chamber.

This valve is provided to simulate actuation of the system by allowing water to flow into the retard chamber and operate the water flow alarm devices.

INSTRUCTORS NOTES	TEACHING POINTS
Ref; Private Protection and Detection, IFSTA, #210 pp. 16-55	WATERFLOW ALARMS Activation of fire alarms is accomplished by the operation of: The alarm check valve The Dry-Pipe Valve or The Deluge Valve. Sprinkler waterflow alarms are normally operated either:
Ref. P. 19	hydraulically or electrically to warn of waterflow.
3-13 SPRINKLERS 3-13.1	The HYDRAULIC ALARM is a local alarm used to alert the personnel in a sprinklered building or a passer-by that water is flowing in the system. This type of alarm uses the water movement in the system to branch off to a water motor, which drives a local alarm gong. The ELECTRIC waterflow alarm is also employed to alert building occupants and, in addition it can be arranged to notify the fire department. With this type of alarm, the water movement presses against a diaphragm which in turn causes a switch to operate the alarm. Prompt notification is essential. Waterflow indicators of the vane type are generally used in WET SYSTEM risers where there are no alarm-type check valves. These detectors are also used in floor laterals for localized notification of the flow of water in the sprinkler system. The VANE-TYPE indicator consists of a flexible vane inserted through a hole drilled in the sprinkler riser of lateral.

INSTRUCTORS NOTES

TEACHING POINTS

Ref; Private Fire Protection and Detection, IFSTA, #210 pp. 16-55

Ref. p. 20

4-14 SPRINKLERS

4-14.8

Ref. P. 21

WATERFLOW ALARMS

The extending end of the vane is connected to a switch mechanism encaed in a housing mounted on the outside of the pipe.

When water flows in the pipe, the vane is deflected, which operates the switch contacts and actuates the alarm transmitter or annunciator.

WATER SUPPLY

Every sprinkler system should have an automatic water supply of:

1. Adequate Volume
2. Adequate Pressure
3. Reliability of Supply

A minimum water supply must be able to deliver the required volume of water to the highest sprinkler head in a building at a residual pressure of 15 psi.

The minimum flow is:

1. Established by the hazard to be protected

and is dependent on:

2. The occupancy and fire loading conditions

TYPES OF WATER SUPPLY

1. Public Water System - A connection to a public water supply system that has adequate volume, pressure and reliability is a good source of water for sprinkler systems.

2. Gravity Tanks - A gravity tank of the proper size also makes a reliable primary water suplly.

   Note: In order to give the minimum required pressure, the bottom of the tank should be at least 35 feet above the highest sprinkler head in the building.

INSTRUCTORS NOTES	TEACHING POINTS
Ref: Private Fire Protection and Detection, IFSTA, #210 pp. 16-55	WATER SUPPLY
	TYPES OF WATER SUPPLY
4-14 SPRINKLERS 4-14.8 Ref. p. 21	3. Pressure Tanks - are another source of water supply and they are usually used in connection with a secondary supply. This type of tank is filled two-thirds full with water and it carries an air pressure of at least 75 psi. These tanks are normally located on the top floor or on the roof of buildings.
	4. Reservoirs - Adequate fire pumps that take suction from large reservoirs are used as a secondary source of water supply. NOTE: When properly powered and supervised, these pumps may be used as a primary source of water supply.
3-13 SPRINKLERS 3-13.1 Refer to Handout #7-8	FIRE DEPARTMENT CONNECTIONS 1. Single Riser System - Fire department connection is attached on the sprinkler-system side of main water supply valve.
Refer to Handout #9	2. Multiple Riser System - the Fire Department Conncetion enters the supply piping between the main supply shutoff and the individual riser shutoff. This design is so that in case the main water supply valve is inadvertently or otherwise closed, water can still be pumped into the system. IMPORTANT: If sectional or floor valves on a multiple riser system are closed the support of the system thru the fire department connection will be negated in that area. A check valve is installed in the feeding water system to prevent fire department pumpers from pumping back into the supply main instead of into the system. Clapper valves are installed in the fire department connection to prevent water from flowing out of the connection when only one hose line has been connected to it.

INSTRUCTORS NOTES

TEACHING POINTS

Ref: Private Fire Protection and Detection, IFSTA, #210 pp. 16-55

3-13 SPRINKLERS

3-13.1 - 3-13.2
Refer to Handout #7-8

Refer to Handout #9

4-14 SPRINKLERS
4-14.6
Ref. p. 24

FIRE DEPARTMENT CONNECTIONS

2. Multiple Riser System

The check valve and ball drip in the fire department connection line are installed to keep the fire department connection dry to prevent freezing.

Most sprinkler systems are designed on the premise that a fire can be controlled by the operation of only a few sprinkler heads.

However some problems can occur:

If a large number of heads are operating the regular water supply may be inadequate resulting in ineffective flows from the heads.

Fire department pumpers operating from hydrants in the same area may reduce the pressure in the system and cause it to be ineffective.

WHENEVER POSSIBLE, fire department pumpers OTHER THAN THOSE SUPPORTING THE SYSTEM should operate from mains OTHER THAN THE PRIMARY SUPPLY MAIN FOR THE SYSTEM.

Fire Department support of standpipes or automatic sprinkler systems should include a standard plan of operations.

Develop 150 psi at the pump and maintain this pressure if possible.

When supplying systems in high-rise buildings or deluge systems a different pump pressure may be required.

This plan cannot be established until fire department personnel become familiar with sprinklered properties they protect.

The plan should cover:

1. Each building
2. Type of occupancy
3. Type of system
4. Extent of system

INSTRUCTORS NOTES	TEACHING POINTS
Ref: Private Fire Protection and Detection, IFSTA #210 pp. 16-55	Therefore an inspection survey is definitely a prequisite.
4-14 SPRINKLERS 4-14.6	A thorough knowledge of the water system is likewise most important, including volume and pressure.
Ref. pp. 24-25-26	These surveys should be diagrammed in a manner similar to that shown in Handout #10.
Refer to Handout #10	Among those things which MUST be considered are: Fire Department connections to systems The water supply available The fire hydrants best suited for use to supply the systems The amount of hose necessary to accomplish the task.
	The following is a suggested guideline for fireground support operations:
Refer to Handout #11	. Pumper should be capable of supplying the necessary water and pressure
Refer to Handout #12	. Use two hoselines (2½" of larger) from pumper to fire department connections
	. A firefighter should immediately check the control valves to assure they are wide open. Where a fire pump is used, check to assure it is operating and valves are open. Open any closed valves. Carry a handlight and portable radio for communications.
3-13 SPRINKLERS 3-13.2	. Fire officer-in-charge shouls locate the fire and order the hose lines charged
	. The pump operator should slowly develop 150 psi at the pump and maintain this pressure if possible. If a third line is placed into the fire department connection, pump at 175-200 psi.
	. Make a quick attack, entering the building with handlines
	. Perform Ventilation as required

INSTRUCTORS NOTES	TEACHING POINTS
Ref; Private Fire Protection and Detection, IFSTA #210 pp. 16-55	. Get to unprotected areas or where sprinkler system distribution may be blocked
	. Do not rob the sprinkler system of the water supply by overtaxing the water system with other pumpers
Ref. pp. 24-25-26	. Support sprinkler system in any exposed property
	. Avoid premature shutoff of a sprinkler system which has been in operation
	. Keep pumper and hoselines attached to sprinkler system during overhaul and station a firefighter at the valve to re-open if necessary.
NOTE: Further information can be obtained from NFPA Standard No. 13E, Fire Department Operations in Properties Protected by Sprinkler and Standpipe Systems.	. See that the sprinkler system is properly restored
	. During inspection, the condition of the fire department connection threads should be checked and protective caps replaced
4-14 SPRINKLERS	TYPES OF SPRINKLER SYSTEMS
4-14.9	The Wet-Pipe System
	Wet-pipe systems contain water under pressure at all times and they are connected to the water supply so that a fused sprinkler head will immediately discharge a water spray in that area and actuate an alarm.
Ref. p. 27	This type of system is usually equipped with an alarm check valve that is installed in the main riser adjacent to where the feed main enters the building.
	This valve actuates an alarm when water flows through the system.
Refer to Handouts #13-14	Incorporated in this valve is a clapper, which is simply an automatic one-way check valve with some additional features.
	Clappers are normally in the closed position.
	When a sprinkler head operates, this clapper opens and permits water to flow to the sprinkler and through the auxiliary valve to a retarding chamber to initiate an alarm signal.

INSTRUCTORS NOTES

TEACHING POINTS

Ref: Private Fire Protection and Detection, IFSTA #210, pp. 16-55

Ref. p. 27

TYPES OF SPRINKLER SYSTEMS

The Wet-Pipe System

RETARDING DEVICES

The retarding chamber is installed between the alarm check valve and alarm-signaling equipment and is employed since water is subjected to variable pressures.

This cahmber is a time-delay device that retards the flow of water to the alarm equipment from the alarm check valve since it must be filled before the water can continue to the alarm equipment. Water drains through the small opening in the bottom of the chamber.

If it were not for the retarding chamber, surges or changes in water pressure would cause the clapper in the alarm valve to rise momentarily and thus transmit false alarms.

Refer to Handout #13

A typical wet-pipe alarm check valve and retarding chamber in both the standby and fire positions are shown in Hnadout #13.

Nother retarding device found where there are flucuations in water pressure is the PRESSURE MAINTENANCE PUMP.

These may be called:

Excess Pressure Pumps

Jockey Pumps

or

Makeup Pumps

These small capacity pumps are electrically operated.

This function is to reduce the running time of the main fire pump and keep it from starting every time there is a surge.

With an initial pressure drop in the system, the jockey pump operates until its capacity is exceeded. The pressure in the system will continue to drop if there are sprinkler heads open. This will cause the sprinkler valve to open and the fire pump to operate charging the system and shutting down the pressure maintenance pumps.

INSTRUCTORS NOTES	TEACHING POINTS
Ref: Private Fire Protection and Detection, IFSTA #210 pp. 16-55	TYPES OF SPRINKLER SYSTEMS The Wet-Pipe System RETARDING DEVICES
Ref. PP. 28-29	Although surges or changes in water pressure are absorbed by the retarding chamber, they may in addition be offset by the use of an EXTERNAL BYPASS LINE. The use of this type of system is most common in areas with excessively high surges in water supply main pressure. With surges of normal intensity in the riser, each successively higher pressure change passes into the system piping through the external bypass line around the clapper valve, which is the line of least resistance. It is then contained or trapped within the system through the function of the check valve in the external bypass unit and accumulates pressure higher than that normally supplying the system. The pressure gauges at the alarm check valve will record these pressures. In most sprinkler systems, two pressure gauges are installed; one above the clapper, which indicates pressure in the system, and one below the clapper, for an independent pressure reading on the supply riser. The accumulation of pressure in the system above the clapper valve, commonly referred to as excess pressure, is an important factor within any sprinkler system and is the basis for efficient and trouble-free service .
Refer to Handout #14	An illustration of the piping arrangement for an external . bypass line is contained in Handout #14 So long as this excess pressure is maintained, the clapper valve will not normally raise from the seated position. Likewise, so long as this tightly seated position is maintained, water is withheld from the connecting piping to the retarding chamber and on to the signaling equipment.

INSTRUCTORS NOTES	TEACHING POINTS
Ref: Private Fire Protection and Detection, IFSTA #210 pp. 16-55	TYPES OF SPRINKLERS SYSTEMS
	The Wet-Pipe System
5-9 SPRINKLERS	OPERATION OF THE SYSTEM
5-9.1	1. When one or more sprinkler heads open, the flow of water lifts the main clapper off its seat and opens the auxiliary valve.
Ref p. 29	2. The water pressure in the main riser pushes the clapper valve to full open position and continues to supply the open sprinklers.
	3. Water also enters the auxiliary alarm valve line and continues to fill the retarding chamber.
	4. When the retarding chamber is full, the water activates the pressure switch, sending an electrical alarm signal and a flow to activate the water-alarm gong.
	To shut down the system turn off the MAIN WATER CONTROL VALVE and open the MAIN DRAIN.
Refer to Handout #15	An illustration of the flow of water in an alarm check valve and related parts during a fire condition is contained in Handout #15.
3-13 SPRINKLERS	USING SPRINKLER STOPS
3-13.4	Until the officer-in-charge has determined that a fire is under control, the MAIN SPRINKLER VALVE MUST NOT BE CLOSED.
Refer to Handout #16	
Ref. p. 30	In order to decrease water damage, a sprinkler tong or wedge can be utilized to shut off the flow of water at the operating heads.
	Several types of sprinkler-head tongs and wedges can be carried in the pockets of turnout coats.
	Other types of tongs are attached to poles, which eliminates the need for a ladder.
	A wedge is made of soft wood which is designed to be driven into position with the heel of the hand until wedged between the sprinkler frame and water orfice.
	If the wedge is properly made, practically all the water flow can be controlled. Sprinkler tongs are more effective in controlling the waterflow because the rubber or neoprene stopper permits no dripping when applied properly. These tongs work on a clamp or lever principle.

INSTRUCTORS NOTES	TEACHING POINTS
Ref: Private Fire Protection and Detection, IFSTA, #210 pp. 16-55	TYPES OF SPRINKLER SYSTEMS The Wet-Pipe System
Ref. p. 30	RESTORING THE SYSTEM A sprinkler system should be installed in accordance with NFPA STANDARD NO. 13. The installing contractor is required to provide the owner with instruction charts which describe the operation and proper maintenance of the system and NFPA STANDARD NO. 13A on care and maintenance. FIRE DEPARTMENT PERSONNEL SHOULD NOT PERFORM SPRINKLER MAINTENANCE AND GENERALLY NOT RESTORE A SYSTEM WHICH HAS BEEN CLOSED DOWN. IT IS THE RESPONSIBILITY OF FIRE DEPARTMENT PERSONNEL TO SEE THAT THE SYSTEM IS RESTORED, BUT IT IS NOT THEIR RESPONSIBILITY TO RESTORE IT. AFTER A FIRE IN SPRINKLERED PROPERTY, IT IS IMPORTANT THAT THE SCENE IS FREQUENTLY RECHECKED UNTIL THE SPRINKLER SYSTEM IS BACK IN SERVICE.
Ref. p. 31	INSPECTING THE SYSTEM Sprinkler systems require periodic inspections and maintenance to perform properly during a fire situation. The plant owner, maintenance personnel, fire prevention personnel and inspection personnel should be able to identify and inspect sprinkler systems when necessary. ROUTINE MAINTENANCE AND RESTORATION OF THE SYSTEM SHOULD BE PERFORMED BY COMPETENT PLANT MAINTENANCE PERSONNEL OR A CONTRACTED SPRINKLER COMPANY. Several important steps should be taken prior to performing any inspection or maintenance on a sprinkler system. . The inspector or maintenance person should review the records of prior inspections and identify the make, model, type and area of protection of the system. . Permission from the plant management should be obtained before performing any inspection activity. The inspection should never be performed without this approval.

INSTRUCTORS NOTES

TEACHING POINTS

Ref: Private Fire Protection and Detection, IFSTA #210 pp. 16-55

Ref. p. 31

TYPES OF SPRINKLER SYSTEMS

The Wet-Pipe System

INSPECTING THE SYSTEM

Fire fighters, fire prevention or inspection personnel should NEVER personally operate, adjust, physically manipulate, alter or handle any sprinkler devices or equipment during situations other than emergencies or planned training sessions.

IT IS PLANT MANAGEMENT'S RESPONSIBILITY TO PROVIDE OR CONTRACT FOR PERSONNEL TO PERFORM THESE FUNCTIONS DURING NORMAL CONDITIONS.

- If equipment is electronically supervised, prior to testing of sprinkler equipment, have plant personnel notify the monitoring organization.
- After all testing is completed the plant personnel should inform the monitoring organization and that organization in turn should advise the plant personnel as to whether or not the correct indicating signals such as, valves opening and closing, waterflow or other supervisory signals were received and that all systems are in operating condition. If this is not the case, then immediate inspection of the system to determine the malfunction(s) must be made.
- Wear appropriate protective clothing for making a thorugh inspection of attics, concealed spaces, and processing or manufacturing areas.

When a fire inspector or maintenance person is charged with the responsibility of performing inspections on wet-pipe systems, their primary concern is with three (3) major areas:

1. Valves
2. Heads
3. Piping

VALVES

Inspect to insure that all valves controlling water supplies to the sprinkler system and within the system (sectional valves) are kept OPEN AT ALL TIMES.

When a valve is closed, report this condition to the responsibile agency and fire department.

INSTRUCTORS NOTES	TEACHING POINTS
Ref: Private Fire Protection and Detection, IFSTA #210 pp. 16-55	TYPES OF SPRINKLER SYSTEMS The Wet-Pipe System INSPECTING THE SYSTEM VALVES
Ref. pp. 32-33	Inspections common to all control valves are listed below. EXAMINE EACH CONTROL VALVE FOR THE FOLLOWING CONDITIONS. . Valve is FULLY OPENED and secured and/or supervised properly in approved manner . Operating wheel is in good condition . Valve is accessible AT ALL TIMES. (If a permanent ladder is provided, check the ladder to see that it is in good condition). . Wrench, when required, is in place. POST INDICATOR VALVES . Inspect PIV to see that it is FULLY OPEN . Try the wrench to feel the spring of the rod when the valve is fully open . Keep the stem backed off about one quarter turn from the full open position . See that the target is properly adjusted to show the words OPEN or CLOSED and that the cover glass is in place and clean . Assure that the PIV headbolts are tight and the barrel casing is intact. . Make sure the wrench is secured to the PIV valve
4-14 SPRINKLERS 4-14.3 4-14.4	MAIN CONTROL VALVE . Inspect the Outside Screw and Yoke valves (OS&Y) to assure that they are FULLY OPEN . That the operating wheel is kept backed off approximately one-quarter turn . The valve stem is clean

INSTRUCTORS NOTES

TEACHING POINTS

Ref: Private Fire Protection and Detection, IFSTA #210 pp. 16-55

Ref. p. 33

5-9 SPRINKLERS

5-9.7

3-13 SPRINKLERS

3-13.1

5-9 SPRINKLERS

5-9.5

Ref. p. 34

TYPES OF SPRINKLER SYSTEMS

The Wet-Pipe System

INSPECTING THE SYSTEM

During normal conditions the inspector should assure:

. The alarm line shutoff cock is completely open

. The pressure gauge valves are open

. The static pressure above the clapper is equal to or greater than the static pressure below the clapper

NOTE: Systems without check valves may only have one pressure gauge on the riser.

. The main drain valve, auxiliary drains and inspector's test valve are closed

. The check ball drip valve in the fire department connection moves freely and allows trapped water to seep out

. The velocity drip valve will move freely and allow trapped water to seep out of the retard chamber

HEADS

It is important to make an immediate examination of sprinklers in areas where changes occur in:

. occupancy
. fire hazard
. heating
. lighting
. mechanical equipment

since these changes may require the installation of different types of sprinkler heads.

Inspect all sprinkler heads to make sure they are clean, not damaged and are free from corrosion.

The need for guards for protection against mechanical damage should be reported

Sprinkler heads in buildings subject to high temperatures should be carefully examined.

Any head showing evidence of weakness should be replaced with heads of proper tempreature rating.

INSTRUCTORS NOTES	TEACHING POINTS
Ref: Private Fire Protection and Detection, IFSTA #210 pp. 16-55	TYPES OF SPRINKLER SYSTEMS The Wet-Pipe System INSPECTING THE SYSTEM HEADS
Ref. p. 34	Weak heads are indicated by: 1. A creeping or sliding apart of the fused parts, which is known as cold flow or 2. By leakage around the head. NOTE: Cold flow is caused by repeated heating of a head to near its operating temperature. Cold flow problems can be eliminated by the use of frangible bulb heads. Sprinkler heads exposed to a corrosive atmosphere should have a special protective coating. Heads that are: . badly corroded , painted . heavily loaded with foreign materials SHOULD BE REPLACED.
5-9 SPRINKLERS 5-9.10	OBSTRUCTIONS TO SPRINKLER HEAD DISCHARGE Partitions or stock should not obstruct the distribution of water discharge from sprinklers and sprinkler heads should be free of hanging displays. A clearance of AT LEAST 18 INCHES should be maintained under sprinklers, measured from the deflector.

INSTRUCTORS NOTES

TEACHING POINTS

Ref: Private Fire Protection and Detection, IFSTA #210 pp. 16-55

4-14 SPRINKLERS

4-14.10

TYPES OF SPRINKLER SYSTEMS

The Wet-Pipe System

SPRINKLER HEAD REPLACEMENT

When changing a sprinkler head, replace it with a head of the same type.

Normally, buildings with a sprinkler system will have a box (in close proimity to the control valve) containing spare heads and a wrench.

HEADS ARE REMOVED COUNTERCLOCKWISE

USE ONLY WRENCH PROVIDED WHEN REMOVING OR INSTALLING HEADS IN A SYSTEM.

Check piping for obstructions and condition of threads, then replace head.

Steps to follow when replacing sprinkler heads on Wet-Pipe Systems:

1. Close main control valve
2. Open main drain
3. Remove head (USE COUNTERCLOCKWISE MOVEMENT)
4. Replace head (MAKING SURE IT IS SAME TYPE)
5. Open inspector's test valve (normally at furthermost and highest point away from the control valve) to relive trapped air.
6. Close main drain
7. Open main control valve
8. If water starts to leak aroind replaced head, tighten head.

NOTE: CARE SHOULD BE EXCERCISED WHEN REPLACING HEADS AS COMPONENTS ARE UNDER STRESS REMEBER, USE ONLY SPRINKLER HEAD WRENCH PROVIDED NOT PLIERS, PIPE WRENCHES OR OTHER TOOLS.

INSTRUCTORS NOTES

TEACHING POINTS

Ref: Private Fire Protection and Detection, IFSTA #210 pp. 16-55

5-9 SPRINKLERS

5-9.3
5-9.4

Ref. p. 35

TYPES OF SPRINKLER SYSTEMS

The Wet-Pipe System

TESTING

1. On a wet-pipe system with an alarm check valve, open the ALARM BYPASS VALVE to test the alarm without unseating the valve.

2. The pressure gauge readings should not change significantly, but the water should flow to the retard chamber (if so equipped) and then to the alarm line.

3. The water motor gong or electric alarm should sound.

4. The retard chamber drain should empty the chamber after the alarm bypass valve is closed.

5. If there is no retard chamber, the alarm line should be drained at the conclusion of the test.

WATERFLOW ALARM TEST

On all types of wet systems, an alarm test should be conducted by using the inspector's test valve.

This valve should be located at the fartherest and highest point of the system.

1. Have one inspector remain at the riser with the second stationed at the inspector's test valve.

2. Open the inspector's test valve, water should then flow from the orfice of the valve.

3. Observe the pressure gauges at the riser.Only a slight variation in pressure should be observed, but the alarm should sound.

4. After hearing the alarm close the inspector's test valve.

INSTRUCTORS NOTES

TEACHING POINTS

Ref: Private Fire Protection and Detection, IFSTA #210 pp. 16-55

ref. P. 36

4-14 SPRINKLERS

4-14.1
4-14.2

TYPES OF SPRINKLER SYSTEMS

The Wet-Pipe System

MAIN DRAIN TEST

1. Observe and record the pressure on the gauge(s) at the system riser.

2. Fully open the 2-inch main drain, observe and record the pressure drop as the alarm sounds.

3. Close the 2-inch main drain and compare readings to previously recorded readings.

If significant differences are noted, a supply valve may be partially closed or an obstruction may be present in the supply line.

On a system using an alarm check valve, take the pressure readings from the lower gauge, since erroneously high static pressures can exist above the valve.

FREQUENCY OF INSPECTION AND TESTING

Systems should be visually inspected at least monthly however a weekly inspection is recommended since it provides the in-plant inspector with continual familiarization with the system and an early discovery of system deficiencies.

Alarm test and waterflow alarm testing should be accomplished only during nonfreezing weather. these tests should be performed at least yearly, but monthly or even weekly tests are recommended.

During tests, all the visual items should also be checked.

The 2-inch main drain test should be conducted at least annually; however a quarterly test is suggested.

The inspector should visually inspect the system and perfo the alarm test in conjunction with the drain test.

A written record should be kept on file after each test.

INSTRUCTORS NOTES	TEACHING POINTS
Ref: Private Fire Protection and Detection, IFSTA #210 pp. 16-55	TYPES OF SPRINKLER SYSTEMS
4-14 SPRINKLERS 4-14.9 Ref. p. 37	The Dry-Pipe System A dry-pipe sprinkler system is one where air under pressure replaces water in the sprinkler piping above the dry-pipe valve. A DRY-PIPE VALVE is a device that keeps water out of the sprinkler piping until a fire actuates a head or heads. Dry-pipe systems should be used in buildings where insufficient heat is maintained to keep water from freezing. When a sprinkler head fuses, permitting the air pressure to escape, the dry-pipe valve automatically opens to permit water to replace the air pressure in the lines.
Ref. p. 38	Dry-pipe valves are designed so that a small amount of air pressure above the dry-pipe valve in the sprinkler piping will hold back a much greater water pressure on the water supply side of the dry-pipe valve.
Refer to Handout #17	Dry systems are equipped with either electric or hydraulic alarm-signaling equipment. Handout #17 illustrates the dry-pipe valve in both the standby and fire positions . The two types of dry-pipe valves that are in use today are the differential and the mechanical. The differential type has a double-seated valve or two clappers of unequal size. The upper seat is considerably larger than the lower, or water, seat with a surface ratio that is normally six to one. The difference in surface area of these two seats determines the difference between water pressure and air pressure that is necessary to "balance" the valve.
Ref. p. 39	The mechanical type of dry-pipe valve, the air and water seats may or may not be of the same area. The air seat (air clapper) under the infuence of air pressure holds the water seat (water clapper) shut through a system multiplying levers.

INSTRUCTORS NOTES	TEACHING POINTS
Ref: Private Fire Protection and Detection, IFSTA #210 pp. 16-55	TYPES OF SPRINKLER SYSTEMS
Ref. p. 39	The Dry-Pipe System Another type of mechanical dry-pipe valve has only one clapper that is held closed by a system of levers. The levers and clapper are released by a difference in air pressure acting on a diaphram. These valves are obsolete and are no longer manufacturered. The required air pressure for dry systems usually ranges between 15 and 50 psi. Air pressure that is needed to service a dry system may be derived from two different sources: a. Plant air service or. b. From unit air pressure that is supplied by a compressor and tank used exclusively for the sprinkler system.
Ref. p. 40	ACCELERATORS/EXHAUSTERS Rules have been established which normally require a quick-opening device to be installed in systems that have a water capacity of over 500 gallons.
Refer to Handout #18	There are two types of quick-opening devices: ACCELERATORS The accelerator unbalances the differential in the dry-pipe valve, causing it to trip more quickly. The exhauster quickly expels the air from the system.
Ref. p. 40 Refer to Handouts #17-19	OPERATION OF THE SYSTEM 1. When one or more sprinklers open, the air pressure is vented through the open heads of the system, thus upsetting the differential within the dry-pipe valve. 2. An exhauster or accelerator will be an aid in speeding-up operation of the system. 3. As the differential is upset, the riser water pressure raises the clapper assembly into the wide-open locked position.

INSTRUCTORS NOTES	TEACHING POINTS
Ref: Private Fire Protection and Detection, IFSTA, #210 pp. 16-55	TYPES OF SPRINKLER SYSTEMS The Dry-Pipe System
Ref. p. 41	OPERATION OF SYSTEM 4. As the water fills the upper chamber of the dry-pipe valve, it also enters the intermediate chamber where it forces the drip check valve closed. 5. It then flows into the alarm line to activate the alarm equipment. 6. The water continues to the open sprinklers.
	RESTORING THE SYSTEM The fire department IS NOT responsible for maintaining or restoring a dry-pipe system, although IT IS the responsibility of fire department personnel to see that the system is restored.
Ref. p. 42	INSPECTING THE SYSTEM During a normal inspection, the inspector should insure that: . All indicating control valves are open and properly supervised in the OPEN position. . Air pressure readings correspond to previously recorded readings. . The ball drip valve will move freely and allow trapped water to seep out of the fire department connection.
NOTE: This valve can be checked by lifting a push rod which extends thru the drip valve opening. Where an automatic drip valve is installed, the valve can be checked by using the push rod located in the valve opening.	. The velocity drip valve located beneath the intermediate chamber is free to move and allow trapped water to seep out. . The fire department connection threads are in good condition and the caps are in place. . Any drum drips are drained to relieve the moisture trapped in the low areas of the system. . During freezing weather, check the dry-pipe valve enclosure heating device at frequent intervals to insure the temperature is maintained at or above 40 degrees F.

INSTRUCTORS NOTES

TEACHING POINTS

Ref: Private Fire Protection and Detection, IFSTA #210 pp. 16.55

Ref. p. 42

NOTE: If the system is equipped with a quick-opening device, opening the priming water test line could trip the system.

If excessive air pressure is noted, it can be drained using the priming water test level valve; however if the system is equipped with a quick-opening device, it is necessary to shutoff the device to prevent tripping the valve.

Close the quick-opening device control valve and open the priming water test valve to reduce the air pressure.Close the valve when the prescribed limit is reached. Before opening the quick-opening device control valve, reduce the air pressure in the quick-opening device until it reaches the pressure in the system.

Ref. pp. 43-44-45

TYPES OF SPRINKLER SYSTEMS
The Dry-Pipe System

INSPECTING THE SYSTEM

- The priming water is at the correct level; drain if necessary by opening the priming water test-level valve until air begins to escape.
- The system's air pressure is maintained at 15-20 psi above the trip point and no air leaks are indicated by rapid or steady air loss.

TESTING

MAIN DRAIN TEST

1. Record the static pressure
2. Fully open the 2-inch main drain slowly to check the waterflow (Open and close the 2-inch main drain very slowly to avoid tripping the dry-pipe valve due to water hammer)
3. Record the flow pressure
4. Close the 2-inch main drain valve SLOWLY
5. Test the alarm by opening the alarm test bypass valve

   (The line from the intermediate chamber should be equipped with a check valve and a globe valve to prevent water from flowing back into the intermediate chamber and tripping the valve. If this is the case, CLOSE THE GLOBE VALVE BEFORE opening the bypass valve to prevent tripping in case the check valve malfunctions)

TRIP TEST

1. Check the system control valve (OS&Y) for sticking by opening the 2-inch main drain slightly while closing and reopening the supply control valve.
2. Close the 2-inch main drain valve
3. Assign one person to open the inspector's test valve and record the time required before water discharges.

INSTRUCTORS NOTES

Ref: Private Fire Protection and Detection, IFSTA #210 pp. 16-55

Ref. pp. 46-47

5-9 SPRINKLERS

5-9.8

TEACHING POINTS

TYPES OF SPRINKLER SYSTEMS
The Dry-Pipe System

TRIP TEST

4. Record tripping point of the dry-pipe valve as indicated by the air pressure gauge.

5. Check water and air pressure gauges to insure pressure equalization has occurred after tripping.

6. Close the supply control valve (OS&Y) and open the main drain valve. (Be sure that the system is completely drained before proceeding.

7. Close the inspector's test valve after the system is drained.

8. Open the dry-pipe valve and check to make sure the clapper is latched in the open position.

9. Clean the clapper seat and any debris from the valve housing, close valve face after reseating the clapper.

10. Add priming water until the priming water level indicator flows water.

11. Pressurize the system with air to the proper level.

12. Restore water pressure by opening the supply control valve with the 2-inch main drain open to avoid tripping the valve.

13. When the supply control valve is completely open, slowly close the main drain valve.

14. Check gauges.

This procedure can take 2 to 4 hours to complete, depending upon the amount and size of the piping in the system and the capacity of the air compressor to pressurize the system.

INSTRUCTORS NOTES

TEACHING POINTS

Ref: Private Fire Protection and Detection, IFSTA #210 pp. 16-55

Ref. p. 48

TYPES OF SPRINKLER SYSTEMS
The Dry-Pipe System

FREQUENCY OF INSPECTION AND TESTING

Dry-Pipe systems should be visually inspected al least weekly.

The Main drain test should be performed at least annually; however a quarterly test is suggested.

The alarm test should be performed at least monthly although a weekly test is recommended.

The trip test should be performed annually.

A written record of all tests and inspections should be kept on file for comparison later.

PRE-ACTION SYSTEM

A PRE-ACTION SYSTEM is a dry system which employs a deluge type valve, fire detection devices and closed sprinkler heads.

Refer to Handout #20

This type of system is used when it is especially important that water damage be prevented, even if pipes should be broken.

The system will not discharge water into the sprinkler piping except in response to the detection system.

A system which contains over 20 heads must be supervised so that should the detection system fail the system would operate automatically.

OPERATION OF SYSTEM

1. The fire detection system detects a fire and operates a release located in the system actuation unit.

2. The deluge valve opens and permits water to enter the distribution system so that water is ready when the heads fuse.

3. When water enters the system, an alarm sounds to give a warning prior to the opening of the sprinkler head.

INSTRUCTORS NOTES	TEACHING POINTS
Ref: Private Fire Protection and Detection, IFSTA #210 pp. 16-55	TYPES OF SPRINKLER SYSTEMS
	PRE-ACTION SYSTEM
Ref. pp. 49-55	INSPECTION AND TESTING
	Is essentially the same as that for a deluge system. See "Deluge Sprinkler Testing".
	DELUGE SYSTEM
	This type of system is ordinarily equipped with open sprinkler heads and a deluge valve.
	Fire detection devices are installed in the same area as sprinkler heads.
	When a fire is detected, the deluge valve is opened, which permits water to flow into the system and out ALL of the sprinkler heads.
	The purpose of a deluge system is to wet down the area in which a fire originates by discharging water from all open heads in the system.
	This system is normally used to protect extra-hazardous occupancies.
	Many modern aircraft hangars are equipped with automatic deluge systems which may be combined with an automatic sprinkler system. A system using partly open and partly closed heads is considered a variation of the deluge system.
	OPERATION OF THE SYSTEM
Ref. p. 49	Activation of the deluge valve may be controlled by a. fire b. heat or smoke detection devices c. manual device
	Deluge valves may be operated
Refer to Handout #20	a. electrically b. pneumatically c. hydraulically

INSTRUCTORS NOTES

TEACHING POINTS

Ref: Private Fire Protection and Detection, IFSTA #210 pp. 15-55

Ref. p. 52

TYPES OF SPRINKLER SYSTEMS

DELUGE OR PRE-ACTION SYSTEMS

INSPECTING THE SYSTEM

Deluge and pre-action systems inspections follow the same guidlines as those performed on wet and dry systems, in regard to piping and valves.

During normal conditions the inspector should insure that:

1. The main supply valve is OPEN and supervised in the OPEN position.
2. Any valves in lines to alarm devices are wide open.
3. The alarm bypass valve is closed.
4. Pressure gauges, water and air (if used) are indicating adequate pressure.
5. Check the drip valve as described under "Dry-Pipe Sprinkler System" for those valves so equipped.
6. The pressure gauges are wide open.
7. No air leaks are evident in pneumatic detection system
8. Fire detection devices are not damaged or corroded.
9. Air maintenance equipment is working properly.
10. There are no air leaks in pre-action system piping.
11. There are no water leaks fron preprimed deluge system sprinkler plugs or caps.
12. Piping and hangars are in good condition, free of corrosion and not subject to physical damage.
13. Sprinkler head cabinets contain a sprinkler wrench and the appropriate number and type of sprinkler heads.

INSTRUCTORS NOTES	TEACHING POINTS
Ref: Private Fire Protection and Detection, IFSTA #210 pp. 16-55	TYPES OF SPRINKLER SYSTEMS DELUGE OR PRE-ACTION SYSTEMS MAIN DRAIN AND ALARM TESTS 1. Record static pressure
Ref. pp. 52-53	2. Open 2-inch main drain SLOWLY to avoid tripping the valve. 3. Record the waterfow pressure. 4. Close main drain SLOWLY. 5. Open the alarm bypadd valve. When alarm sounds return valve to closed position.
Ref. pp. 53-54	TRIP TEST 1. On a small deluge system replace open sprinklers with standard sprinkler plugs or caps. On large systems where the heads cannot be replaced or plugged, close the main water supply (OS&Y) to within two turns from closed, trip the valve and immediately close the water supply control valve (OS&Y) 2. Activate the system by using a heating device on a detector or by manual means. 3. Close main water supply (OS&Y) valve and drain the system using the 2-inch main drain valve. 4. Open valve faceplate, clean the valve seat and any debris from valve housing. 5. Unlatch the clapper and reset the valve* 6. Reinstall the faceplate. 7. On pre-action systems, pressurize the system with air to the proper level. 8. Restore water pressure by opening the supply control valve with the 2-inch main drain valve open to avoid tripping the valve. When the supply control valve is completely open, SLOWLY close the 2-inch main drain valve. 9. On deluge systems, remove plugs or caps from sprinkler or reinstall open heads.

INSTRUCTORS NOTES	TEACHING POINTS
Ref: Private Fire Protection and Detection, IFSTA #210 pp. 16-55	TYPES OF SPRINKLER SYSTEMS DELUGE OR PRE-ACTION SYSTEMS TRIP TEST *Some deluge and pre-action valves do not require resetting by removal of the faceplate. Refer to manufacturer's instructions for proper resetting procedure.
Ref. p. 55	FREQUENCY OF INSPECTION AND TESTING Visually inspected at least monthly, preferably weekly. Main drain test at least annually, quarterly tests recommended. Trip test at least annually with a written record of all tests and inspections to be made and filed.
4-14 SPRINKLERS 4-14.7	PARTIAL COVERAGE SYSTEMS Occasionally, and sometimes as a result of local ordinance, partial sprinkler protection for specific hazard areas is required. These areas: Basements Kitchens Stairways might be chosen with the intent of protecting vital areas of escape or areas of high hazard while avoiding theexpense of a total sprinkler system. This reasoning however often fails to take into account certain fire behavior. In fact, the NFPA statistics insprinkler performance lists "partial installation" as second only to water to sprinklers shut off as a major cause of unsatisfactory sprinkler performance.
4-14 SPRINKLERS 4-14.5	Automatic sprinklers are also the most effective measure preventing loss of life by fire. The effect on occupants is real in that fire loss records show a very low loss of life in sprinklered buildings; where deaths were recorded, explosions or burning clothing were often involved. The effect on occupants is also psychological

INSTRUCTORS NOTES	TEACHING POINTS
Ref: Private Fire Protection and detection, IFSTA, #210 pp. 105-115	STANDPIPE SYSTEMS
	Standpipe systems are primarily for the purpose of providing fire stations at each floor level.
	These stations may be located at various places on each floor and they may also be located on roofs of buildings.
Ref. p. 105	Likewise, there are several types of standpipe systems which are classified and discussed in this section.
	A standpipe system must be supplied with adequate water and pressure in order to be effective.
	Properly installed systems provide a quick and convenient means for operating fire streams on various floors of buildings..
	These standpipe stations are essentially indoor fire hose connections.
	If the system is of the type which permits fire department pumpers to supply the indoor network of pipe, the various stations function similar to discharge ports from a pumper.
	Proper pressure must be maintained at the pumper and this pressure must be calculated for the highest floor of operation.
	Other types of standpipes may be equipped with small fire hose and nozzles (1½-inch) for use by occupants of buildings as a first defense fire fighting medium.
	The small hose and nozzle for this purpose, are kept attached to the standpipe outlet that may be supplied by either a direct connection to the domestic water supply, a fire department pumper or both.

INSTRUCTORS NOTES	TEACHING POINTS
Ref: Private Fire Protection and Detection, IFSTA #210 pp. 16-55 4-14 SPRINKLERS 4-14.5	in that they that they have a sense of security, and possible panic conditions are reduced. Sprinklers are doubly useful because they both sound the alarm of fire and also immediately begin to apply water.

INSTRUCTORS NOTES	TEACHING POINTS
Ref. Private Fire Protection and Detection, IFSTA #210 pp. 105-115 Ref. p. 105	CLASSES OF STANDPIPE SYSTEMS The various standpipe systems are grouped into three general classes of service based upon intended use. CLASS I: For use by fire departments and those trained in handling heavy fire streams (2½-inch hose). This class of service must be capable of furnishing the effective fire streams required during the more advanced stages of fire on the inside of buildings or for exposure fire protection.
Ref. p. 106	CLASS II: For use primarily by the building occupants until the arrival of the fire department. (small hose) This class of service must afford a ready means for the control of incipient fires by the occupants of the building during working hours and by watchmen and those present during the nightime and holidays.
	CLASS III: For use by fire department personnel and those trained in handling heavy streams or by building occupants This class of service must be capable of furnishing firefighters the effective fire streams required during the more advanced stages of fire on the inside of buildings as well as providing a ready means for the control of fires by the occupants of the building. In addition to the above, there also exists a combined system, where the water piping serves both 2½-inch outlets for fire department use and outlets for automatic sprinklers.
	WATER SUPPLY FOR STANDPIPE SYSTEMS The amount of water required for standpipe systems depends upon the size and number of fire streams that will be needed and probable length of time they will be used. Both of these factors are largely influenced by the condition of the building or plant. When the character of the water supply must be studied and specific conditions such as acceptability, pumps, tanks and sprinkler systems must be considered, NFPA Standard No. 14, Standard for the Installation of Standpipe and Hose Systems should be consulted.

INSTRUCTORS NOTES

TEACHING POINTS

Ref: Private Fire Protection and Detection, IFSTA #210 pp. 105-115

Ref. p. 107

MINIMUM SUPPLY FOR CLASS I SERVICE

Class I service requires a water supply sufficient to provide 500 gpm for at least 30 minutes.

Where more than one standpipe is required, the minimum supply shall be:

500 gpm for the first standpipe

and

250 gpm for EACH additional standpipe

for a period of at least 30 minutes.

The supply must be sufficient to maintain a residual pressure of 65 psi at the topmost outlet with 500 gpm flowing.

MINIMUM SUPPLY FOR CLASS II SERVICE

Class II service must be sufficient to provide 100 gpm for at least 30 minutes.

The supply must be sufficient to maintain a residual pressure of 65 psi at the topmost outlet with 100 gpm flowing.

MINIMUM SUPPLY FOR CLASS III SERVICE

Class III service requires a water supply sufficient to provide the same flow and same residual pressure for the same time as stipulated for Class I service.

TYPES OF STANDPIPE SYSTEMS

There are four (4) different types of standpipe systems currently in use.

They are;

. WET STANDPIPE SYSTEMS that have the water supply valve open and water maintained throughout the system at all times.

. DRY STANDPIPE SYSTEMS that admit water to the system through the operation of a manually activated, approved remote control device located at each hose station.

INSTRUCTORS NOTES	TEACHING POINTS
Ref: Private Fire Protection and Detection, IFSTA #210 pp. 105-115 Ref. p. 107	**TYPES OF STANDPIPE SYSTEMS** . DRY STANDPIPE SYSTEMS that admit water to the system automatically through the use of approved devices such as dry-pipe valves. This system is activated by the opening of a discharge outlet valve which depletes the air from the system. It is applicable to unheated structures. . DRY STANDPIPE SYSTEMS that have no permanent water supply and must be charged by the fire department. **PRESSURE REDUCING VALVES** Where pressure at the standpipe outlet exceeds 100 psi an approved device should be installed at the outlet to reduce the pressure with the required flow at the outlet to 100 psi. For Class II and III systems this device would not normally be adjustable to provide pressure higher than 100 psi. Where pressure is greater than 150 psi, an appropriate warning sign should be installed.
Ref. p. 108	**STANDPIPES IN HIGH-RISE BUILDINGS** The requirements established in NFPA Standard No. 14 specifies that standpipe systems shall be limited to 275 feet of height. The standard further specifies that buildings in excess of 275 feet of height shall be zoned accordingly. The term"zone" is used to signify those upper and lower levels of a building which are services by standpipes. It should be remembered that 275 feet is a maximum height and lower-level zones may be less. Example: A 25-story building may be approximately 325 feet in height. The lower-level zone may be established somewhat short of 275 feet, provided the high-level zone is not excessive. Therfore, the lower-level zone could be approximately 200 feet, while the high-level zone would be 125 feet. In no case, however, shall the two zones exceed 550 feet in height.

INSTRUCTORS NOTES

TEACHING POINTS

Ref: Private Fire Protection and Detection, IFSTA #210 pp. 105-115

Refer to Handouts #21-22

Ref. p. 109

STANDPIPE IN HIGH-RISE BUILDINGS

A typical two-zone standpipe system and an alternative two-zone system are illustrated by line drawings in Handouts #21-22.

FIRE DEPARTMENT CONNECTIONS

One or more siamese connections through which a fire department pumper can supply water into a standpipe system is required for each Class I or III standpipe system.

High-rise buildings having having two or more zones require a siamese connection for each zone.

Standard requirements specify there shall be no shutoff valve between the siamese connection and the standpipe riser.

An approved straightway check valve, however, must be installed and located as near as practical to the point where the siamese connection joins the system.

The hose connections of the siamese must be of the female type and equipped with standard caps.

In Wisconsin these connections MUST have National Standard Threads.

The siamese (fire department) hose connection must be designated by a raised letter sign on a plate or fitting reading "STANDPIPE".

If the siamese connection does not service all of the building and appropriate sign must be attached indicating the portion of the building served.

Ref. p. 110

INSPECTING AND TESTING OF STANDPIPES

Initial Installation

A new standpipe installation should be checked to insure the following:

. All devices are listed by a nationally recognized testing laboratory.

. Hose stations are in no case over six feet from the floor and are with in easy reach when standing on the floor.

INSTRUCTORS NOTES	TEACHING POINTS
Ref: Private Fire Protection and Detection, IFSTA #210 pp. 105-115 Ref. p. 110	**INSPECTING AND TESTING OF STANDPIPES** **Initial Installation** . Each hose cabinet or closet is provided with a conspicuous which reads "FIRE HOSE" and/or "FIRE HOSE FOR USE BY OCCUPANTS OF BUILDING." . Fire department connections have National Standard Threads in Wisconsin and are posted with a sign reading "STANDPIPE." . Dry standpipes are posted with "DRY STANDPIPE FOR FIRE DEPARTMENT USE ONLY." . The system components are tested hydrostactically at not less than 200 psi for two hours. . Piping, feed mains and connections are flushed to remove all construction debris and trash. **INSPECTION** An inspector must insure that: . Wet standpipe systems are inspected at regular intervals with the normal recommendation being every six months. The inspection should include; water supply tanks, either pressure or gravity-type, and fire pumps. . Hose cabinets and closets are used for fire equipment only. . Water supply control valves are checked and sealed open. . Individual discharge outlets are checked for proper operation, gasket condition, presence of corrosion and leaks.. . Discharge outlet threads are inspected for damage. . Tanks are checked for proper water level; if pressurized, that at least 75 psi is maintained and that precautions against freezing are taken when necessary. . Dry standpipe system piping is inspected annually. . Discharge outlets in a dry system are checked to see that they are closed.
NOTE: If the operation of valves in the wet system will be done during the inspection, the main water supply valve should be closed and the system drained before initiating the tests. DO NOT FORGET TO RE-OPEN THE WATER SUPPLY VALVE UPON COMPLETION OF INSPECTION.	

INSTRUCTORS NOTES

TEACHING POINTS

Ref: Private Fire Protection and Detection, IFSTA #210 pp. 105-115

Ref. p. 111

INSPECTING AND TESTING OF STANDPIPES

INSPECTING

. The hose is inspected for general conditions, dryness and proper position on the swingout rack or holder.

It should be removed and reracked periodically so that it will not deteriorate at the bends. The swingout rack should be checked for ease of operations.

. The threads on the combination nozzles and couplings are not damaged and the rubber gaskets are in good condition.

. The combination nozzle is not obstructed and the valve is working freely.

. The fire department connection is inspected for access, protective caps, damage to threads, proper operation of the check valve and that no debris has been placed in the connection which would obstruct the flow of water.

. Drains are checked to be free of dirt or sediment.

TESTING

The following standpipe testing program should be adopted.

. Dry standpipe systems shall be hydrostaically tested at least every five years.

. Any standpipe system out of service for a period of time shall be tested with air at 25 psi to insure tightness.

. Fire pumps supplying standpipe systems should be tested weekly for starting and operating.

FIRE DEPARTMENT OPERATIONS WITH STANDPIPES

Fire departments responding to locations which have standpipes should conduct preplanning surveys in order to develop overall standard operating procedures for the ground level, fire area and all support functions.

NFPA Standard No. 13E, FIRE DEPARTMENT OPERATIONS IN PROPERTIES PROTECTED BY SPRINKLER AND STANDPIPE SYSTEMS and IFSTA 304 FIRE PROBLEMS IN HIGH-RISE BUILDINGS will be of assistance in preparing adequate procedures.

INSTRUCTORS NOTES

TEACHING POINTS

Ref: Private Fire Protection and Detection, IFSTA #210 pp. 140-153

Ref. p. 140

DETECTION SYSTEMS

PRODUCTS-OF-COMBUSTION DETECTORS

Products-of-combustion detectors include the group devices generally called fire detectors.

Their operation is designed to occur when one of the four major groups of detectable products of combustion occur.

The four major detectable products of combustion are:

1. Heat
2. Visible Products (Smoke)
3. Invisible Products (Ionized Gases)
4. Light

Fire has other products of combustion, but those listed are the general groups which, in addidtion to being detectable, are indicative of fire.

This is to say that the amount, concentration, or degree of the product is discernible from other naturally occurring products.

Therefore, when the product is detected, it is acceptable to assume the existence of a fire is at least highly probable.

An example of a product of combustion which would not be distinguishable would be carbon dioxide (CO_2).

The presence of CO_2 is easily detectable by some devices, and it is a product of combustion in a high percentage of all fires.

The problem is that carbon dioxide is the fourth most abundant gas in the atmosphere, and it is a by-product of animal and plant respirations and many other processes.

Therefore, its presence could not be indicative of the presence of fire.

INSTRUCTORS NOTES

TEACHING POINTS

Ref: Private Fire Protection and Detection, IFSTA #210 pp. 140-153

Ref. p. 141

DETECTION SYSTEMS

HEAT DETECTORS

Heat is an abundant product of Combustion.

It is detectable by certain devices using three primary principles of heat physics:

FIRST: heat causes the expansion action of metal

SECOND; it causes a melting action

THIRD: the thermoelectric characteristics of heated metal are detectable.

Three groups of devices use these primary principles to detect fire.

1. Fixed-Temperature Detector
2. Rate-of-Rise Detector
3. Combination Fixed-Temperature Rate-of-Rise Detector

FIXED TEMPERATURE

The fixed-temperature devices are designed to activate at a given temperature. The two most common types use the characteristic of melting material to detect fire.

The first type of fixed temperature devices is bimetallic, which uses the expansion characteristics of melting material to detect fire.

Two metals or metal alloys with different expansion ratios when heated are used.

These metals are formed into this strips and bonded together to form a single strip.

The effect of the heat on the combined metal (bimetal) strip will make the metal with the larger expansion ration expand more rapidly.

This will cause the bimetal strip to arc toward the side of the strip made up of the metal with the lower expansion ratio.

INSTRUCTORS NOTES

TEACHING POINTS

Ref: Private Fire Protection and Detection, IFSTA #210 pp. 140-153

Ref. p. 141

Refer to Handout #23

DETECTION SYSTEMS

HEAT DETECTORS

FIXED TEMPERATURE

The amount of curve and difference in expansion of the two metals at a specific temperature is mathematically or experimentally calculated.

Then the bimetal strip is placed into a housing in a manner that causes two electrical contacts to close when a given amount of arc is reached.

Most bimetallic detectors are considered to be self-resetting.

This gives them the advantage of not having to be replaced after a fire.

IT IS IMPORTANT however, to check the detectors after a fire to insure that permanent damage has not resulted.

Ref. p. 142

The second type of fixed-temperature detection devices are based upon the principle that most materials will melt when exposed to heat.

Moreover the melting temperature of most metals is very specific.

This is to say that a solid, e.g., ice, melts at 32 degrees F., and the temperature for this melting will not change.

Therefore if a device was needed to send an alarm when the temperature reached 32 degrees F., ice could be used by placing a small layer of ice between two contacts.

When the ice melts at 32 degrees F., the contacts will come together sending an alarm.

Realistically, soft metal alloys and thermoplastic resins are used for these applications.

Solder is often used for this purpose.

By altering the alloy composition of a metal, a very specific melting tempreature can be achieved.

INSTRUCTORS NOTES	TEACHING POINTS
Ref: Private Fire Protection and Detection, IFSTA #210 pp. 140-153	DETECTION SYSTEMS
	HEAT DETECTORS
Ref. p. 142	FIXED TEMPERATURE
	The solder is usually utilized to hold a two-piece link or latching mechanism together.
	When the solder melts, the link separates or the latch is released, causing an alarm signal to be sent.
Refer to Fig. 2 Handout #24	Thermoplastic polymens can also be manufactured to melt at a very specific temperature.
	These polymens are used to insulate steel wires which are then wound around each other to form a tension cable.
	When the melting temperature of the polymen is reached, the tension of the wires causes the wires to twist through the plastic and short together, sending an alarm.
	These cables can be run along large areas forming a continous fixed temperature alarm device.
	After a fire, the melted section of cable is cut out and replaced with new unmelted cable.
Refer to Fig. 1 Handout #24	Another type of detection cable, which employs the melting of a chemical salt insulation, is utilized.
	The chemical salt is not electrically conductive as a solid, but it is very much so when a liquid.
	The temperature at which the salt melts can be carefully controlled by adding certain chemicals.
	The cable can be designed to signal when the temperature reaches a predetermined level.
	The advantage of this type of cable over the thermoplastic is that it does not have to be replaced after a fire, because as soon as the salt resolidifies it no longer conducts current.
	The disadvantage is that it is more limited in its application capabilities since sharp bends, twisting and connections are more difficult to achieve.
	Cable detectors are normally referred to as line-type detectors while noncable are known as spot-type.

INSTRUCTORS NOTES

TEACHING POINTS

Ref: Private Fire Protection and Detection, IFSTA #210 pp. 140-153

DETECTION SYSTEMS

DETECTOR RATINGS

Ref. p. 143

NORMAL CEILING TEMPERATURE		TEMPERATURE RATING OF DETECTORS
Ordinary	Less than 100 Degrees F.	135 to 160 degrees F.
Intermediate	100 to 150 degrees F.	175 to 225 degrees F.
High	150 to 225 degrees F.	250 to 300 degrees F.
Extra High	225 to 300 degrees F.	325 to 360 degrees F.

Refer to Handout #25

RATE-OF-RISE

Ref. p. 144

Rate-of-Rise depend almost exclusively on the expansion characteristic of heat.

The main exception is the thermoelectric rate-of-rise detector.

Most rate-of-rise detectors employ a small chamber filled with air, with the bottom made of a flexible metal diaphram.

These are known as pneumatic rate-of-rise detectors.

Refer to Handout #26

As the air inside the chamber expands, the diaphram is forced out.

When it is forced out to a predetermined level, it forces a set of electrical contacts to open or close.

This change of current initiates an alarm signal to the alarm panel.

The most common rate-of-rise pneumatic detectors are individual detectors known as spot detectors.

These detectors appear to be semispheres mounted on a base.

These are typically brass colored.

It must be noted, though, THAT IF THEY ARE PAINTED BY OTHER THAN THE MANUFACTURER, THEY MUST BE REPLACED.

Ref. p. 145

A second type of pneumatic rate-of-rise temperature detection system uses tubing arranged over the area of coverage.

INSTRUCTORS NOTES	TEACHING POINTS
Ref: Private Fire Protection and Detection, IFSTA #210 pp. 140-153	DETECTION SYSTEMS HEAT DETECTORS
Ref. p. 145	RATE-OF-RISE The space inside the tubing acts as the chamber. The tubing is attached to an actuation vessel that has a flexible diaphram.
Refer to Handout #27	This diaphram performs the same function as those in the base of the spot detectors chamber and is vented similarly. Some pneumatic-tube detection systems may have large vessels or heat activation devices piped in to monito a specific area of coverage.
Ref. p. 146	Another type of rate-of-rise detector is known as a rate-compensated detector. This detector uses a bimetallic activation principle. A metallicsleeve with a moderate expansion rate, holding two bowed struts of a slow expansion rate, is used to accomplish the necessary rate adjustment.
Refer to Handout #28	The lower-expansion strips are bowed and held secure at both ends inside the metal sleeve. The strips have electrical contacts attached. In the normal position, the strips bow out and do not allow the contacts to come together. As the temperature increases rapidly, the metal sleeve which houses the strips elongates more rapidly than the strips. This action relieves the tension on the strips and allows the contacts to come together. If the rate of temperature change is relatively slow, less than 5 degrees F., the metal strip expands at a rate fast enough to maintain the tension inside the sleeve. This prevents the contacts from coming together.

INSTRUCTORS NOTES

TEACHING POINTS

Ref: Private Fire Protection and Detection, IFSTA #210 pp. 140-153

Ref. p. 147

DETECTION SYSTEMS

HEAT DETECTORS

RATE-OF-RISE

The last type of rate-of-rise detector utilizes the thermoelectric sensors to detect rapid changes in temperature.

Refer to Handout #29

DETECTOR	SENSITIVITY	RELIABILITY	STABILITY
Fixed Temperature	Poor	Good	Good
Rate-of-Rise	Fair	Fair	Good
Rate Compensate	Fair	Good	Good
Invisible Products-of-Combustion	Good	Fair	Fair
Visible Products-of-Combustion	Good	Fair	Fair
Flame-Ultrviolet	Good	Fair	Fair
Flame-Infrared	Good	Fair	Poor

Ref p. 148

COMBINATION RATE-OF-RISE FIXED-TEMPERATURE

Refer to Handout #30

These detectors are exactly what the name implies; a combination of a rate-of-rise detector with a fixed-temperature.

This allows the higher sensitivity of the rate-of-rise to be coupled with the higher dependability of the fixed-temperature detector.

VISIBLE PRODUCTS-OF-COMBUSTION

Visible-products-of-combustion detectors are manufactured utilizing a photoelectric cell coupled with a specific light source.

The phtoelectric cell is a flat disc, which when exposed to light transforms the light into electrical current.

INSTRUCTORS NOTES	TEACHING POINTS
Ref: Private Fire Protection and Detection, IFSTA #210 pp. 140-153	DETECTION SYSTEMS
	VISIBLE PRODUCTS-OF-COMBUSTION
Ref. p. 148-149	This cell is employed in two fashions to detect smoke; the first is the beam application and the second is the refractory application.
	The beam application utilizes a beam of light focused across the are being monitored onto the photoelectric cell.
Refer to Handout #31	
	The cell is constantly converting the beam into current.
	This current is used to electronically keep a switch open.
	As long as the beam is striking the photoelectric cell the switch is kept open.
	When smoke blocks the path of the beam the current ceases to be produced and the switch falls closed indicating an alarm signal.
Ref. p. 150	The refractory photo cell application utilizes the photo cell in an opposite application.
	A light beam is passed through a small chamber toward the end away from the light source.
	The light does not normally strike the photo cell and no current is normally produced.
	An electronic switch working opposite of the one used for beam applications is used.
	The switch is open when no current is flowing.
Refer to Handout #32	Air is drawn through the chamber constantly.
	When smoke is drawn through the chamber it causes the light beam to be refracted (scattered) in random directions.
	A portion of the scattered light strikes the photocell initiating a current
	This current closes the electronic switch activating the alarm signal.

INSTRUCTORS NOTES	TEACHING POINTS
Ref: Private Fire Protection and Detection, IFSTA #210 pp. 140-153	DETECTION SYSTEMS
	INVISIBLE PRODUCTS-OF-COMBUSTION
Ref. pp. 150-151	A phenomenon of fire is the ionization of molecules as they undergo combustion.
	The molecules have an electrem imbalance and will tend to rob electrons from other molecules.
	The invisible products-of-combustion detector utilizes this phenomenon for operation.
Refer to Handout #33	The detector has a semi-open sensing chamber to sample the room air.
	A small amount of radioactive material is placed adjacent to the opening in the chamber.
	This radioactive material ionizez the air particles as they enter.
	Inside the chamber are two electrical plates.
	One is positively charged and one negatively cahrged.
	The negatively charged plate is closer to the radio-active source than the positive.
	The action of the particles ionizezed by the radio-active material is to free an electron, which travels to the positive plate and causes a minute current to flow between the charged plates.
	When ionized products of combustion enter the chamber they pick up the free electrons caused by the radio-active ionization.
	This causes the current flowing across the plates to cease, and initiates an alarm signal.
Ref. P. 152	LIGHT DETECTORS INFRARED
Refer to Handout #34	Infrared detectors operate best when separated from possible sources of ignition.
	This makes there use in monitoring large areas very effective.
	It also requires the use of dual filtering action to remove background infrared radiation.

INSTRUCTORS NOTES	TEACHING POINTS
Ref: Private Fire Protection and Detection, IFSTA #210 pp. 140-153 Ref. p.p. 152-153	DETECTION SYSTEMS LIGHT DETECTORS INFRARED Additionally, a time delay is usually incorporated to eliminate other source of non-fire infrared radiation.

UNIT QUIZ

1. The vertical pipes supplying the sprinkler system are called :

   (Circle the letter in front of the correct answer)

   a. feed main

   b. cross main

   c. branch line

   d. risers

2. The mains supplying the riser or cross mains are called:

   (Circle the letter in front of the correct answer)

   a. feed mains d. risers

   b. cross mains

   c. branch line

3. Pipes directly supplying the lines in which sprinklers are placed are called:

   (Circle the letter in front of the correct answer)

   a. feed mains

   b. cross mains

   c. branch lines

   d. risers

4. Sprinklers are placed on:

   (Circle the letter in front of the correct answer)

   a. feed mains

   b. cross mains

   c. branch lines

   d. risers

5. List the four major sprinkler valves.

   a. _____

   b. _____

   c. _____

   d. _____

6. PIV stands for _____

7. OS&Y stands for _____

8. The color code for an ORDINARY sprinkler head is:

   (Circle the letter in front of the correct answer)

   a. unpainted

   b. white

   c. blue

   d. red

   e. green

   f. orange

9. When the accelerator on a system operates, the air pressure _____

   _____.

10. When an exhauster on s system operates, the air pressure _____

    _____

11. The maximum allowable distance between sprinklers in a light hazard occupancy is:

    (Circle the letter in front of the correct answer)

    a. 15 ft

    b. 20 ft

    c. 12 ft

    d. 25 ft

12. A deluge system contains:

(Circle the letter in front of the correct answer)

a. water under pressure at all times

b. air and water under pressure at all times

c. open heads

d. air under pressure at all times

13. Describe one method of activating a deluge system:

_____

_____

_____

14. The wet pipe system contains:

(Circle the letter in front of the correct answer)

a. water under pressure at all times

b. air and water under pressure at all times

c. open heads

d. air under pressure at all times

15. The dry pipe system contains _____ in the system above the _____

_____.

ANSWER KEY

1. d

2. a

3. b

4. c.

5. wet-pipe
   dry-pipe
   pre-action
   deluge

6. Post Indicator Valve

7. Outside Screw & Yoke

8. Ordinary - unpainted
   Intermediate - White
   High - Blue
   Extra high - Red
   Very extra high - Green
   Ultra high - orange

9. pushed into intermediate chamber

10. air is expelled to ground

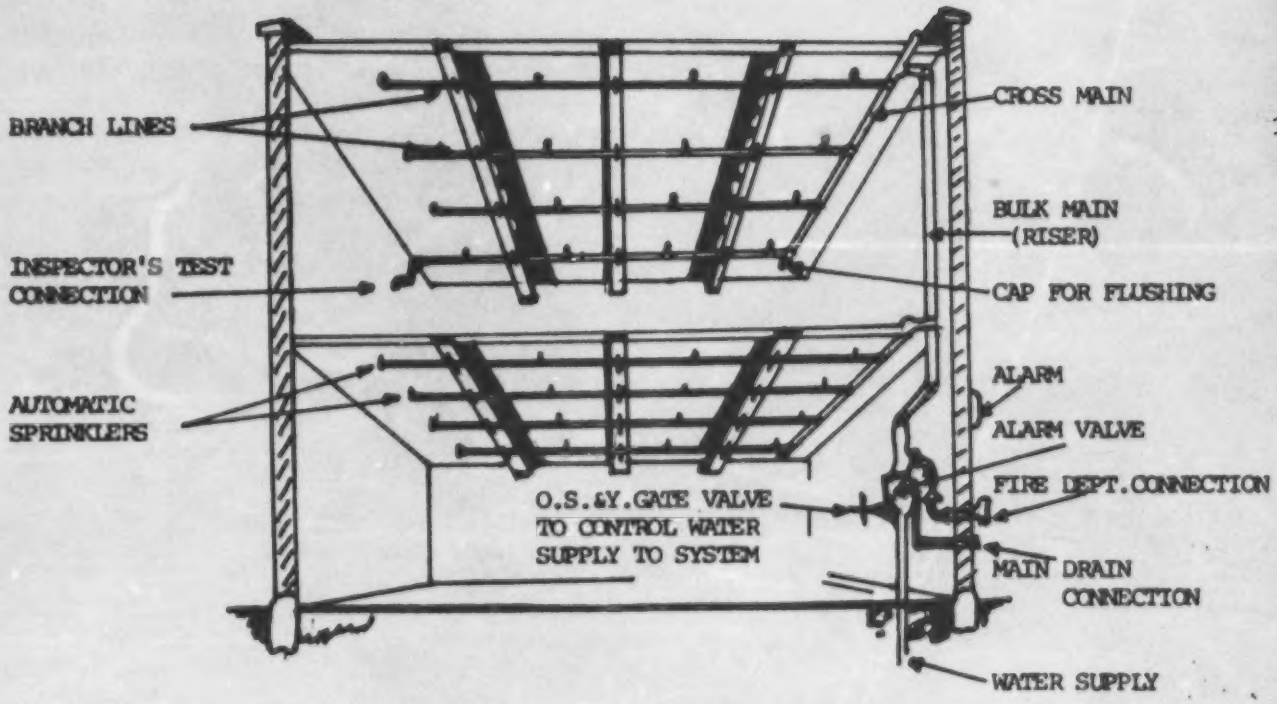
11. Light hazard - 15 feet
    Ordinary Hazard - 15 Feet
    Extra Hazard - 12 feet

12. c

13. Manual Operation
    Heat Activated

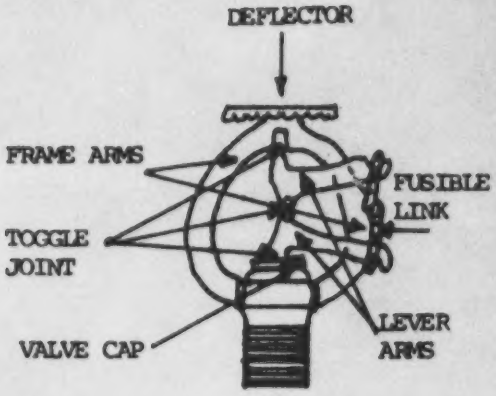
14. a

15. air dry-pipe valve



SPRINKLER SYSTEM PIPING LAYOUT

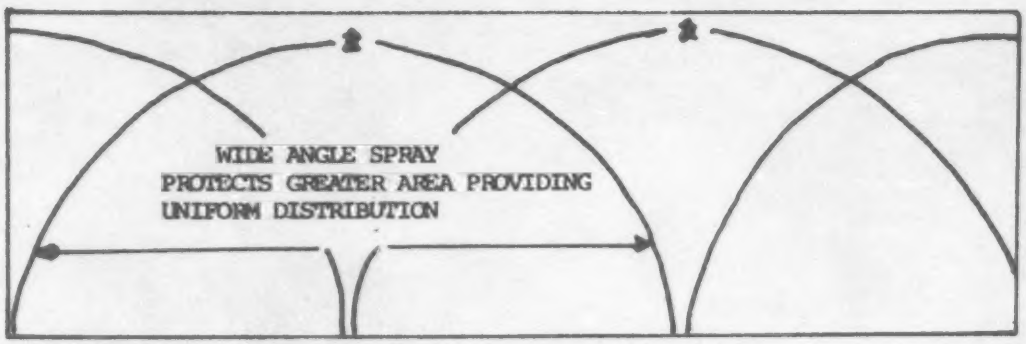
SPRINKLER HEAD CONSTRUCTION/OPERATION



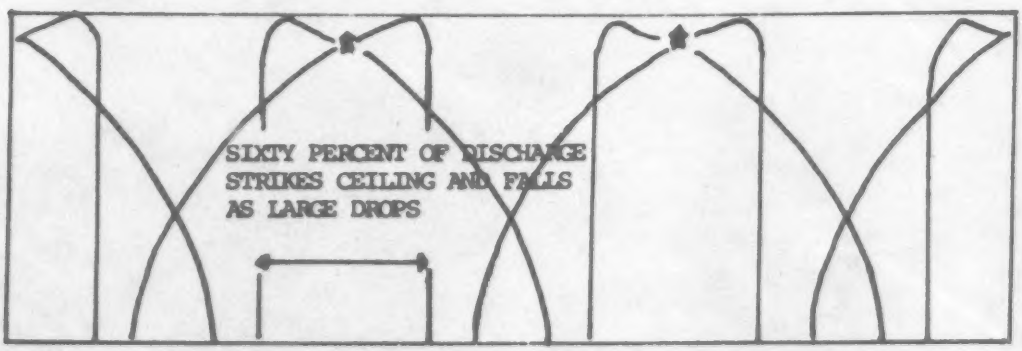
UPRIGHT SPRINKLER HEAD
ILLUSTRATING THE ACTIVATION
OF THE FUSIBLE LINK

ILLUSTRATION OF HOW WATER
FLOWS THRU THE HEAD AFTER
THE FUSIBLE LINK HAS ACTUATED

OCCUPANCY HAZARD	ORFICE	PROTECTION AREA	
LIGHT	1/2 inch	130 to 168 sq. ft. 200 or more sq. ft. permitted under some circumstances	Consider construction feature
	3/8 inch	65 to 100 sq. ft.	
ORDINARY	1/2 inch	130 sq. ft. 15 ft. between branch lines and sprinklers Except 100 sq. ft. for high piled stock	
EXTRA	1/2 or 17/32 inch	90 sq. ft. 12 ft. between branch lines and sprinklers	Depending on construction features and hazardous steps and processes



DISCHARGE PATTERN OF STANDARD SPRINKLERS



DISCHARGE PATTERN OF OLD-STYLE SPRINKLERS

SPRINKLER TEMPERATURE RATINGS

TEMPERATURE RATINGS DEGREE F.	TEMPERATURE CLASSIFICATION	FRAME COLOR
135 to 170	Ordinary	Unpainted (or partly black or chrome)
175 to 225	Intermediate	White*
250 to 300	High	Blue
325 to 375	Extra High	Red
400 to 475	Very Extra High	Green
500 to 575	Ultra High	Orange

* The 135 degree sprinklers of some manufacturers are half black and half painted. The 175 degree sprinklers of these same manufacturers are yellow.

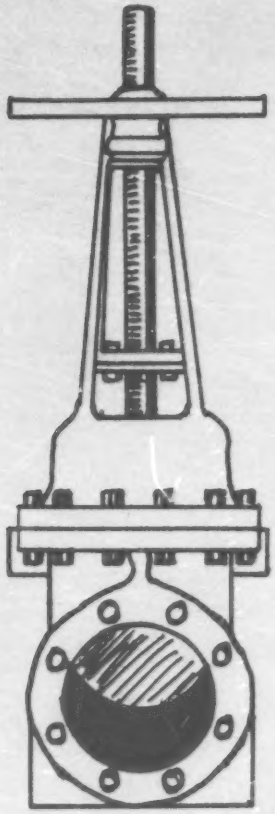


Fig. 1

An OPEN STEM AND YOKE VALVE (OS&Y) IN A PRACTICALLY OPEN POSITION
For proper sprinkler operation these valves MUST be maintained in the FULLY opened position.

Fig. 2

A POST INDICATOR VALVE (PIV) in the OPEN position. If the valve is closed the word SHUT will appear.

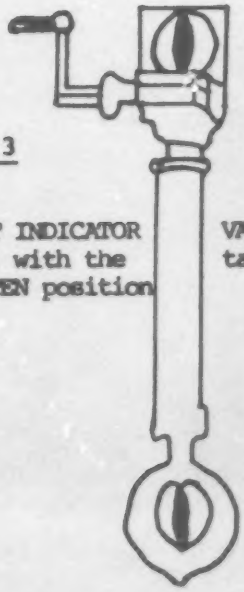
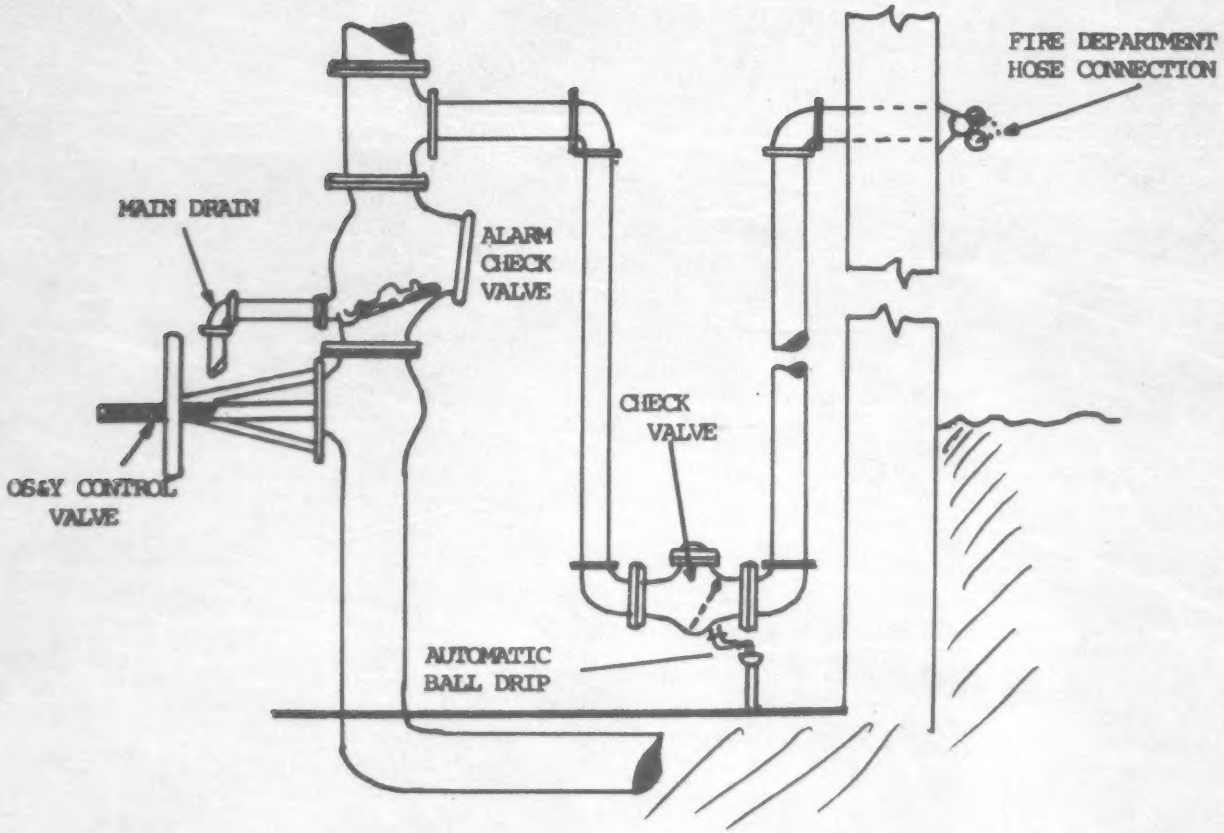


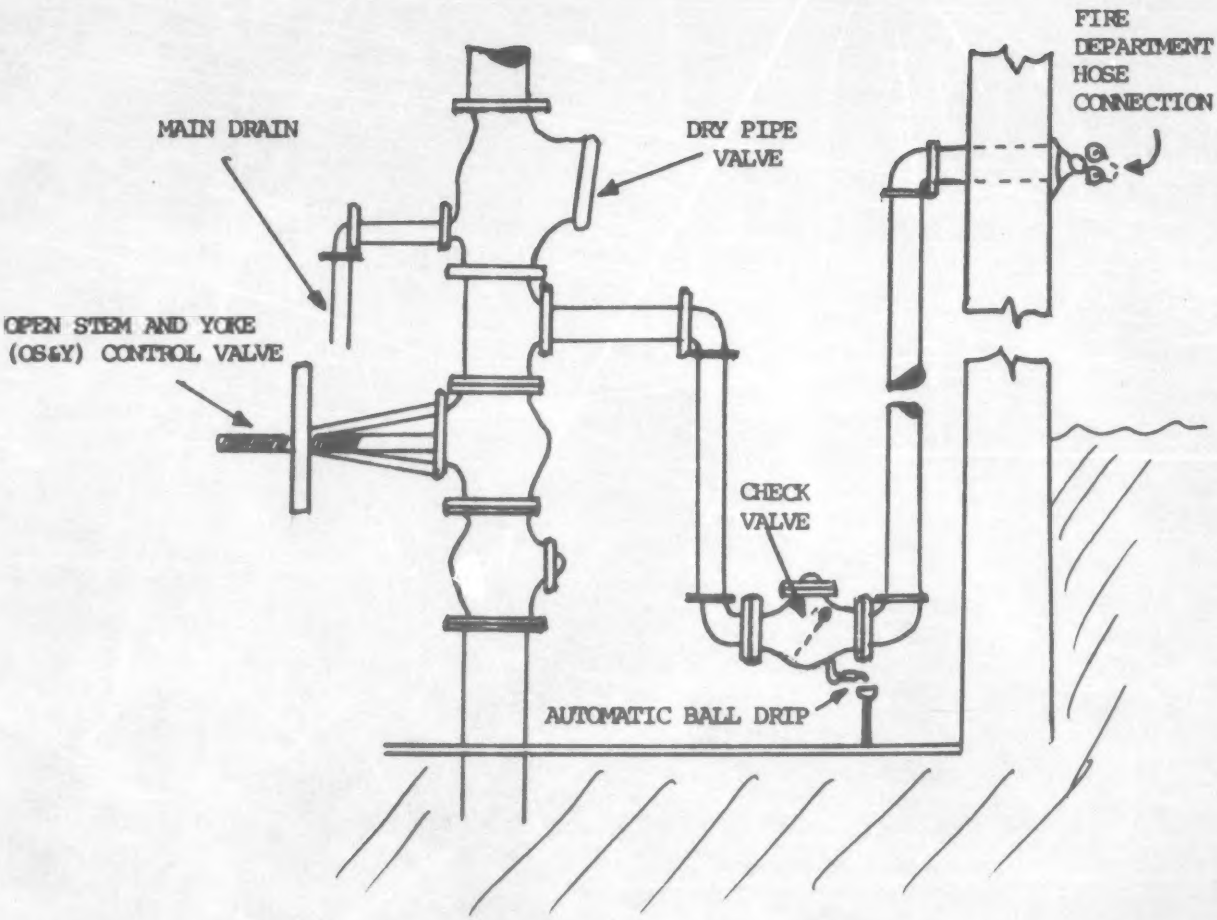
Fig. 3

A POST INDICATOR VALVE ASSEMBLY (PIVA) with the target in the OPEN position

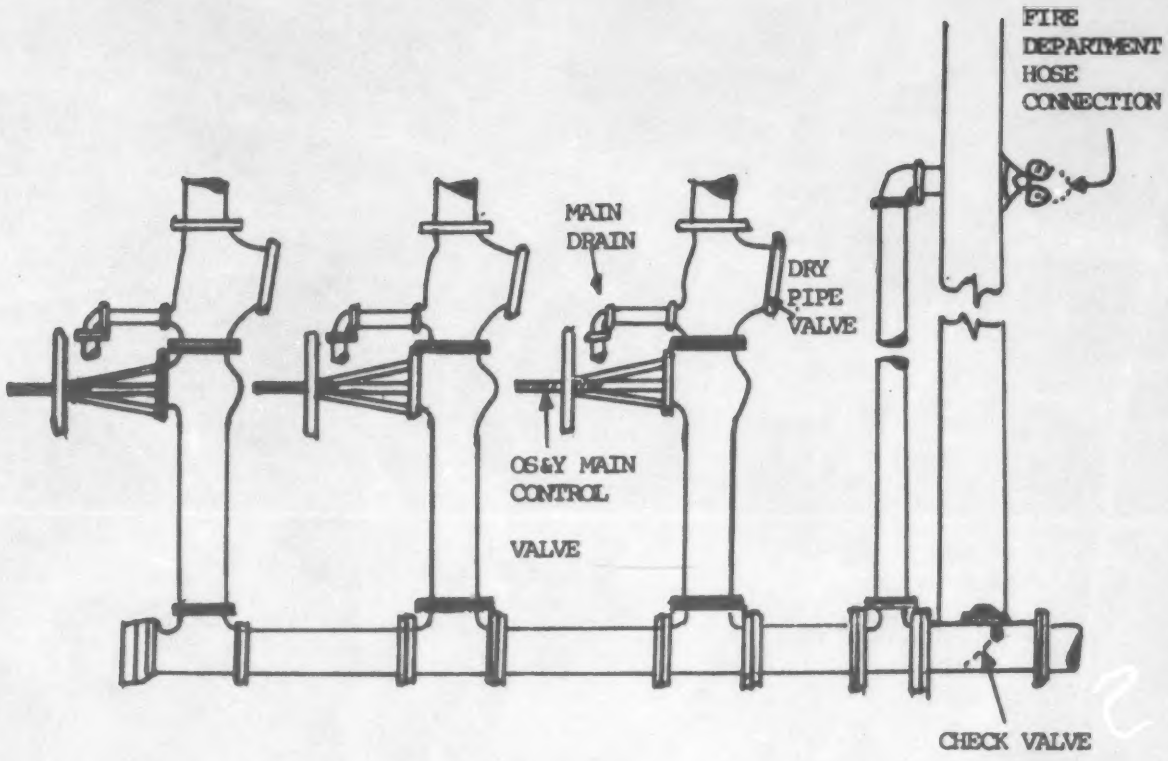
FIRE DEPARTMENT CONNECTION ON A SINGLE RISER WET PIPE SYSTEM

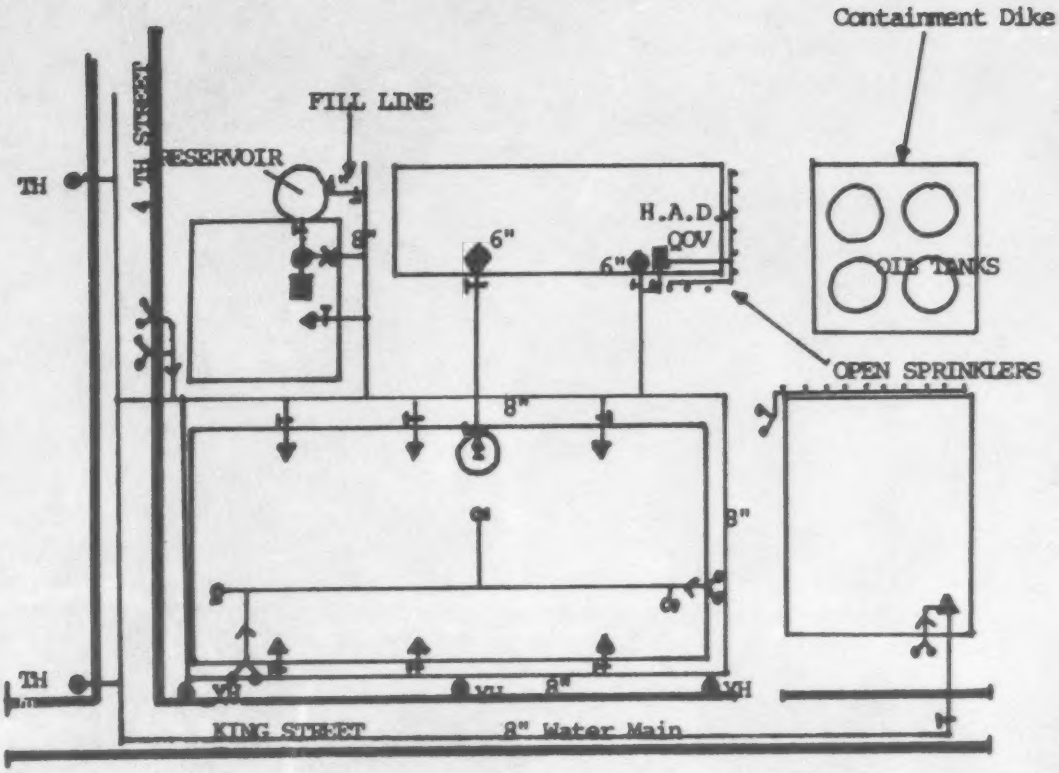


FIRE DEPARTMENT CONNECTION ON A SINGLE RISER DRY PIPE SYSTEM



FIRE DEPARTMENT CONNECTION ON A MULTI-RISER SYSTEM

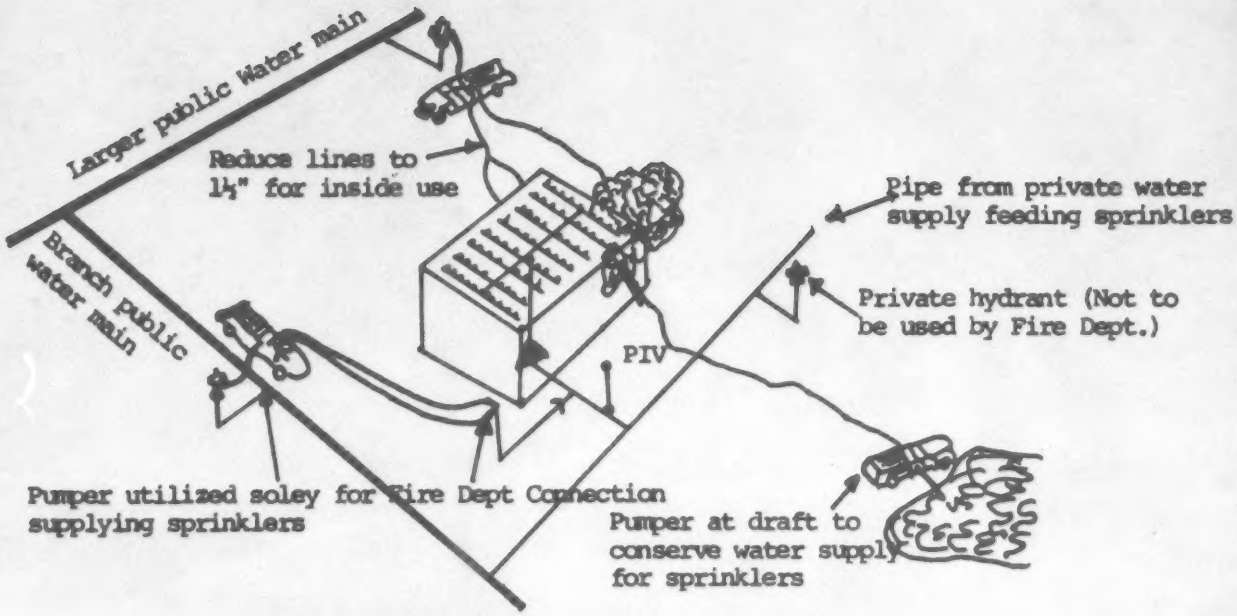




TYPICAL INSPECTION SURVEY DIAGRAM

CODE:
- TH Public Hydrant 3 Outlets
- YH Yard Hydrant (Private 2 Outlets
- H.A.D Heat Actuating Device
- QOV Quick Opening Valve
- FD Connections
- Alarm Valves
- Centrifugal Fire Pump
- Check Valve
- Dry Pipe Valve
- Indicator Valve

STANDARD PLAN OF OPERATIONS FOR FIRE DEPARTMENT SUPPORT OF AUTOMATIC SPRINKLER SYSTEMS


Larger public Water main
Reduce lines to 1¼" for inside use
Pipe from private water supply feeding sprinklers
Private hydrant (Not to be used by Fire Dept.)
Branch public water main
PIV
Pumper utilized soley for Fire Dept Connection supplying sprinklers
Pumper at draft to conserve water supply for sprinklers

(Reproduced through the courtesy of IFSTA and NFPA)

SUGGESTED GUIDELINE FOR FIREGROUND SUPPORT OPERATIONS

. Pumper should be capable of supplying the necessary water and pressure

. Use two hoselines (2½ inch or larger) from pumper to fire department connection

. A firefighter should immediately check the control valves to assure they are wide open. Where a fire pump is used, check to assure it is operating and valves are open. Open any closed valves. Carry a handlight and portable radio for communications.

. Fire officer-in-charge should locate the fire and order the hose lines charged.

. The pump operator should slowly develop 150 psi at the pump and maintain this pressure if possible. If a third line is placed into the fire department connection, pump at 175-200 psi.

. Make a quick attack, entering the building with handlines.

. Perform ventilation as required.

. Go to unprotected areas or where sprinkler system distribution may be blocked.

. Do not rob the sprinkler system of the water supply by overtaxing the water system with other pumpers.

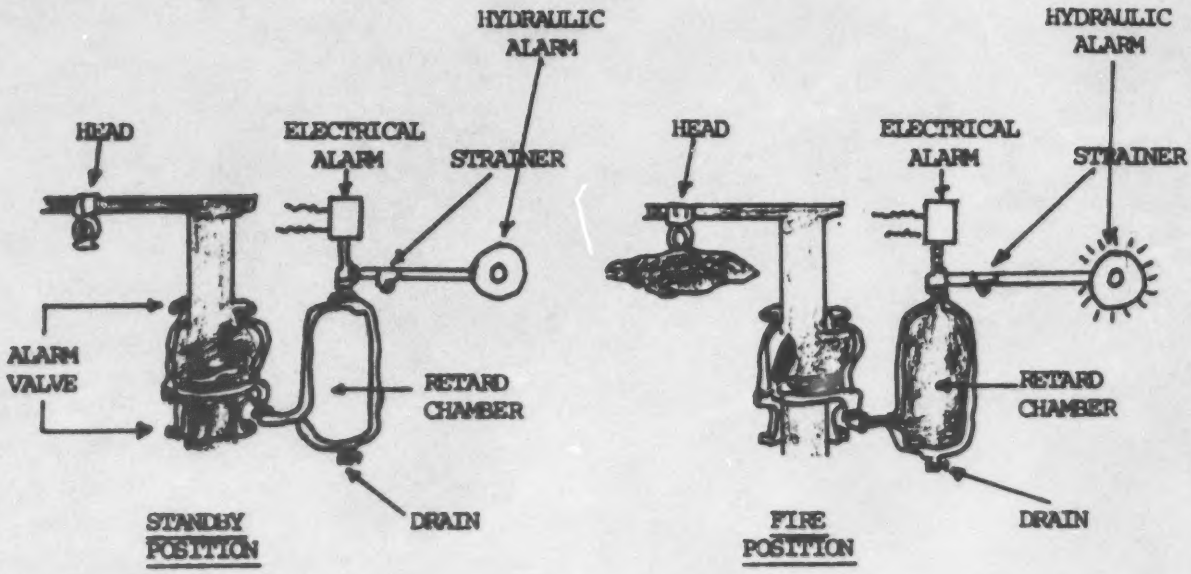
. Support sprinkler system in any exposed property.

. Avoid premature shutoff of a sprinkler system which has been in operation.

. Keep pumper and hoselines attached to sprinkler system during overhaul and station a firefighter at the valve to re-open if necessary.

. See that the sprinkler system is properly restored.

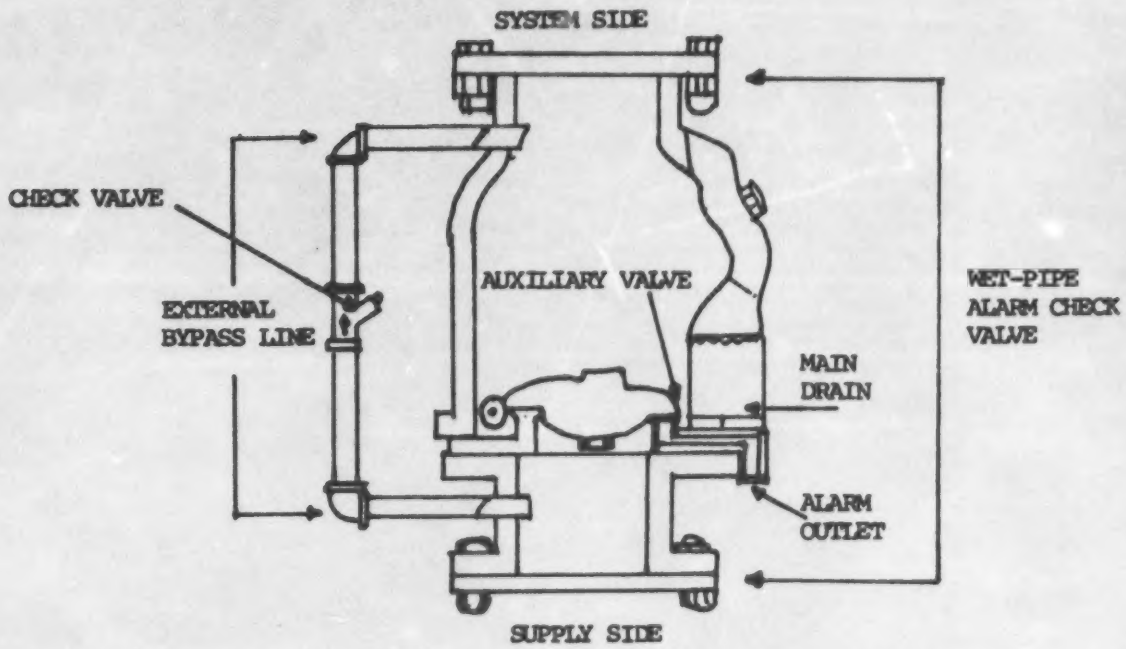
. During inspection, the condition of the fire department connection threads should be checked and protective caps replaced.



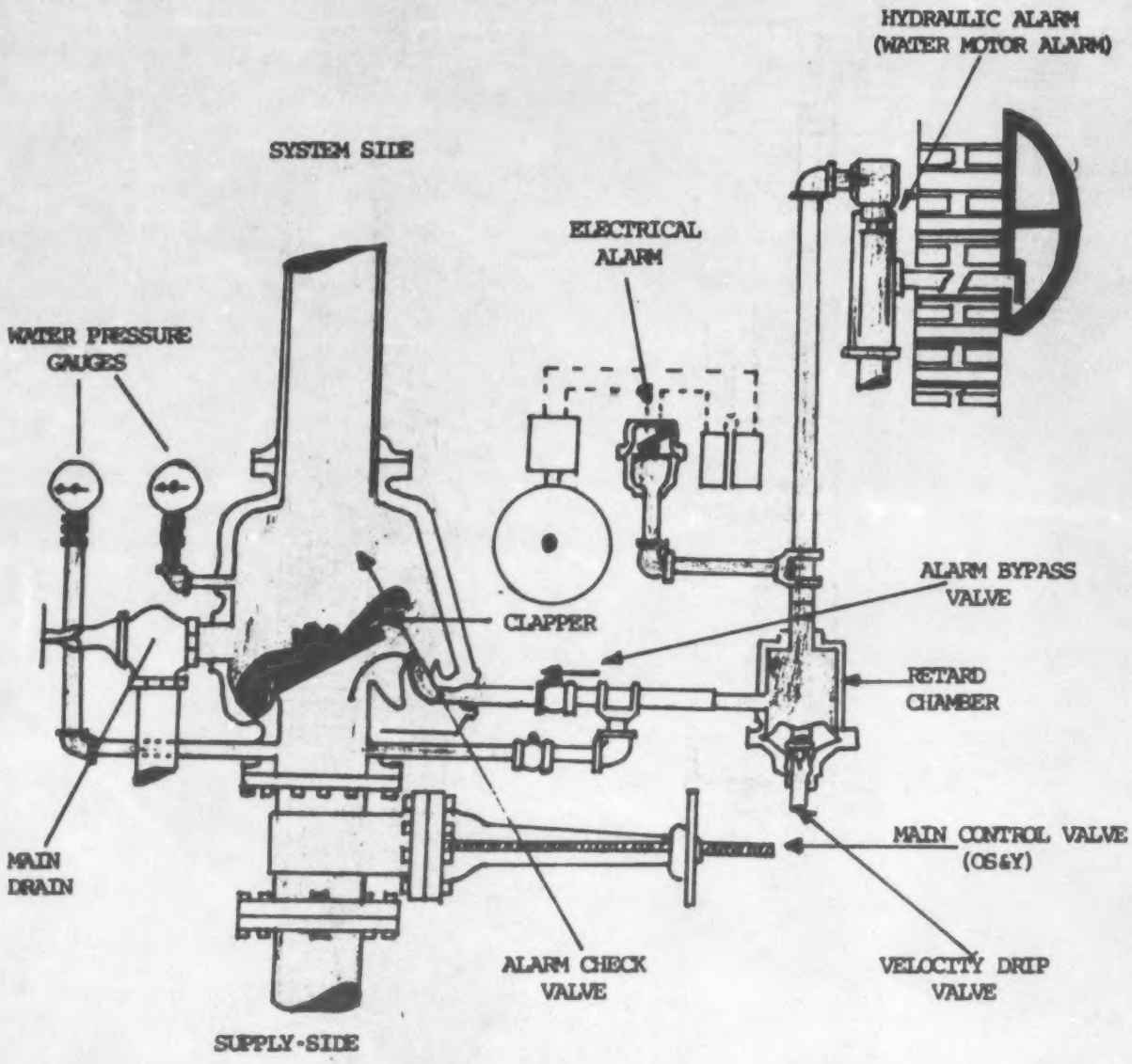
A typical wet-pipe alarm check valve and retard chamber in both the standby and fire positions.

The retard system prevents normal pressure surges from tripping the alarm valve and sounding an alarm.

WET-PIPE ALARM CHECK VALVE

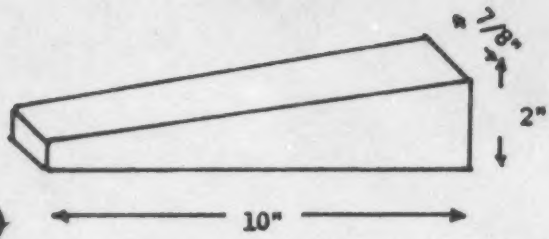


This illustration shows the use of an external bypass line to prevent false alarms due to surges in the system instead of a retard chamber.

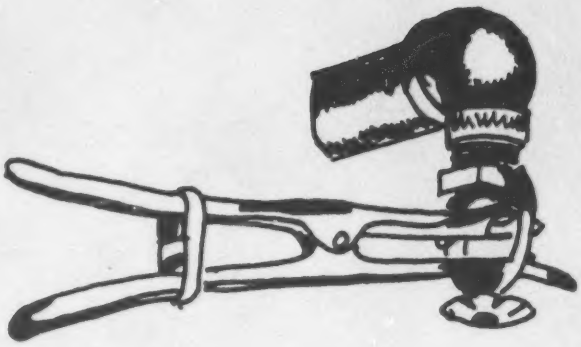


This is the flow of water in an alarm check valve and related parts during a fire condition.

SPRINKLER STOPS

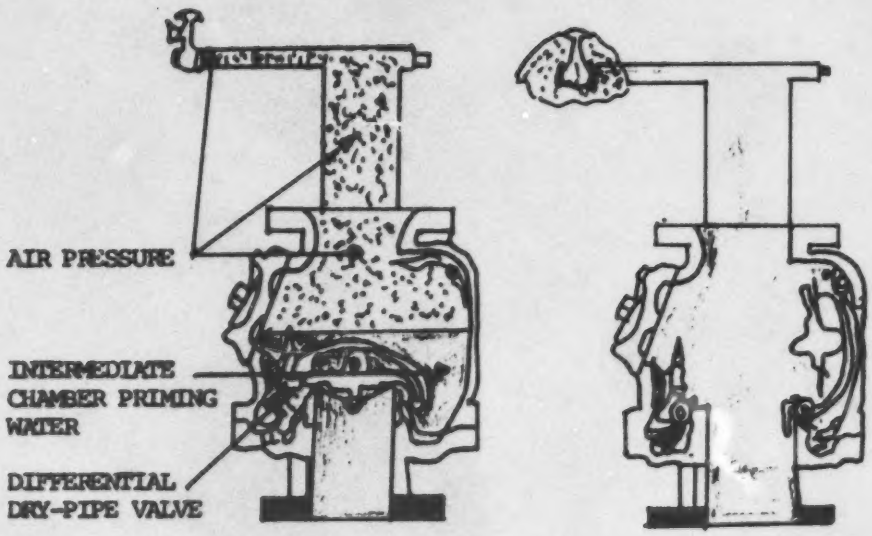


A wooden, home-made sprinkler stop. Strip of rubber on top increases wedging



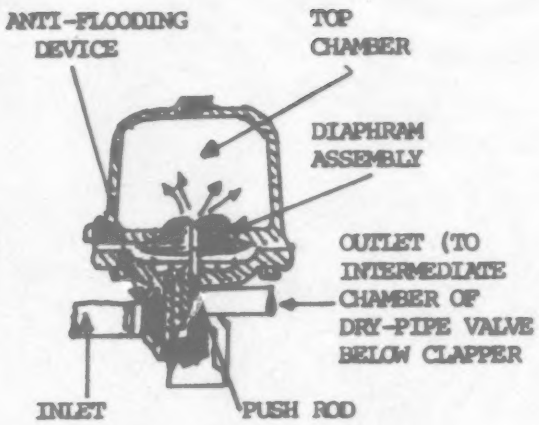
Sprinkler Tongs effectively stop water flow

DRY-PIPE ALARM VALVE



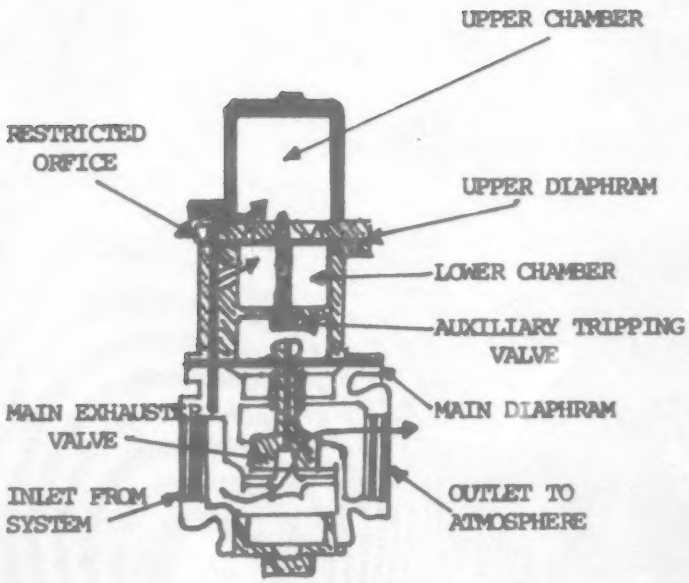
STANDBY POSITION FIRE POSITION

ACCELERATORS AND EXHAUSTERS



DRY PIPE ACCELERATOR

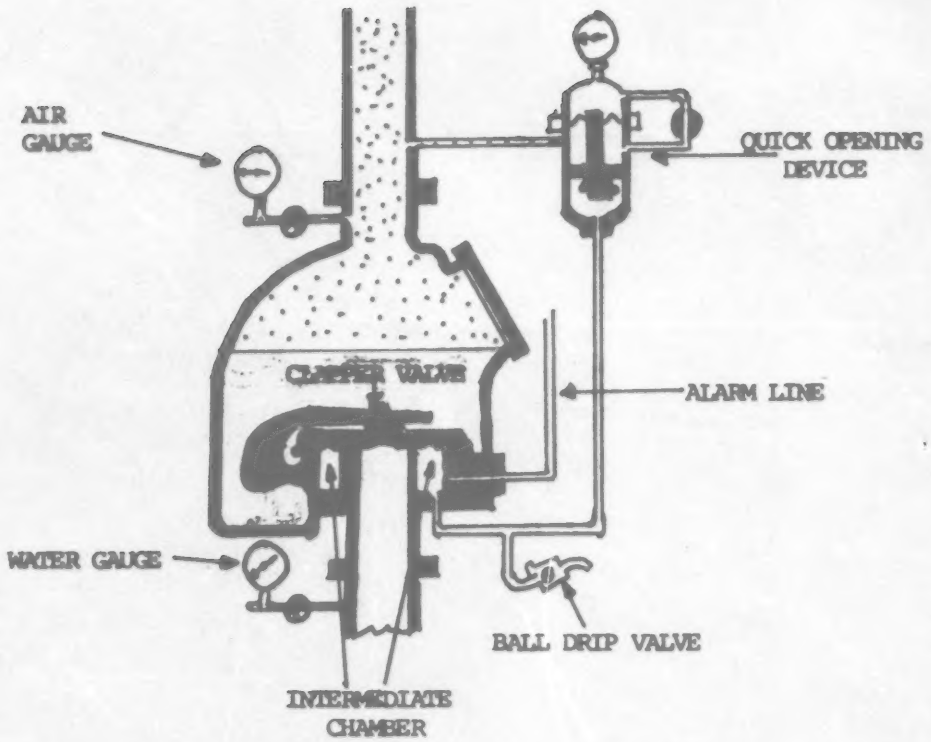
When activated by a reduction in pressure, a dry-pipe accelerator channels air pressure to the intermediate chamber directly under the clapper valve, thus forcing it open.



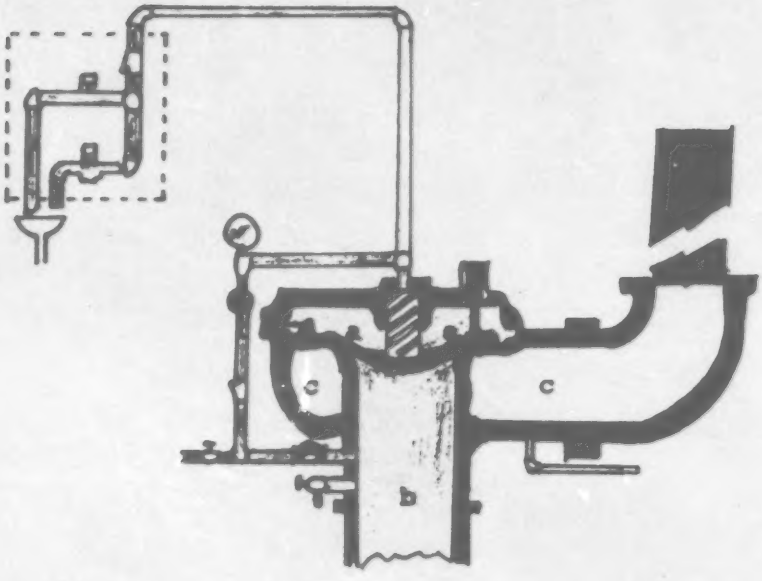
DRY-PIPE EXHAUSTER

When activated by a reduction in air pressure , a dry-pipe exhauster discharges existing system air pressure to the atmosphere.

DRY-PIPE VALVE

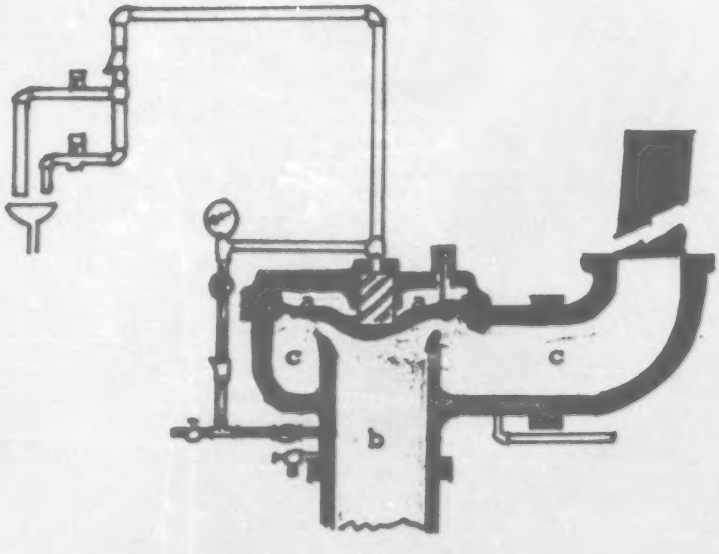


DELUGE VALVES



STANDBY POSITION

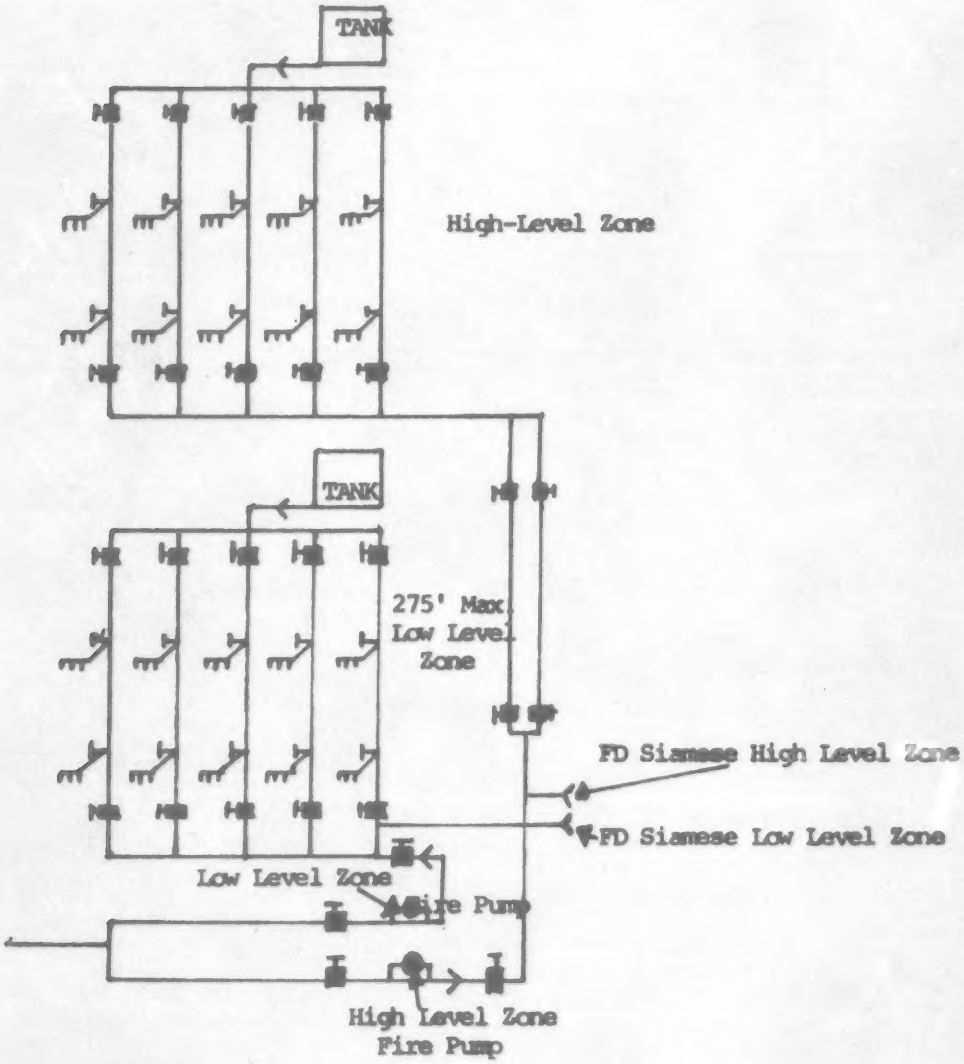
Water pressure in Chamber A maintains the valve in a closed position



FIRE POSITION

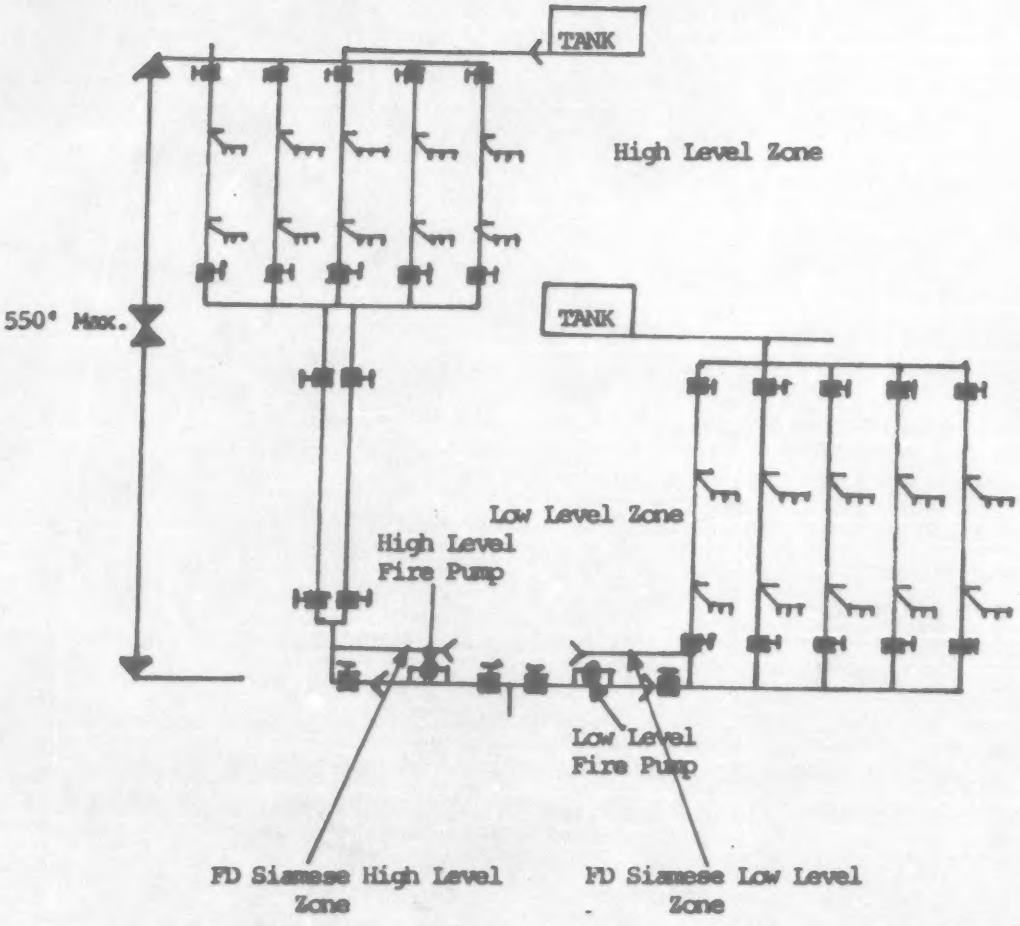
When the system operates, Chamber A has a loss in pressure, allowing Chamber B pressure to open the valve and charge the system thru Chamber C piping.

A TYPICAL TWO ZONE SYSTEM



A two-zone standpipe system can provide water to floors and a roof up to 550 feet above the ground

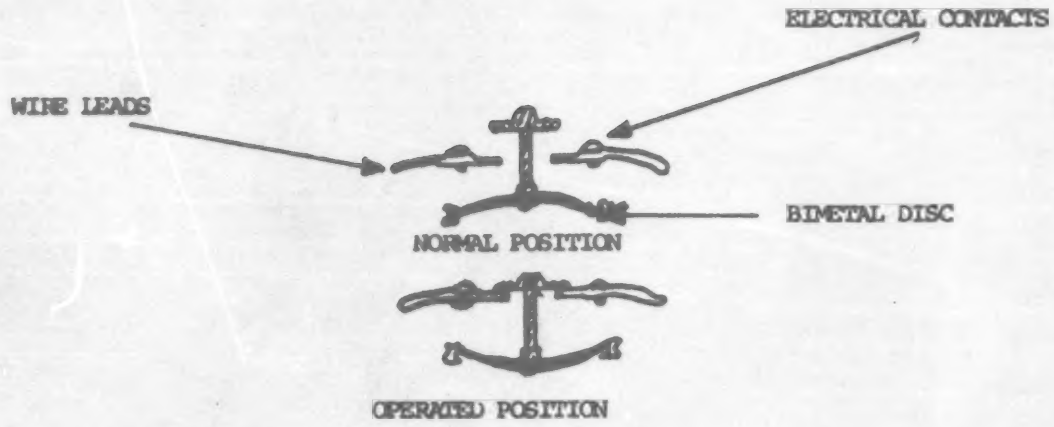
ALTERNATE TWO-ZONE STANDPIPE SYSTEM



An alternative method of supplying a two-zone standpipe system using fire pumps, gravity tanks and fire department connections.

FIXED TEMPERATURE

HEAT DETECTORS



A bimetalic strip housed in a bowed position can be designed to invert when heated.

This principle is used to manufacture restorable fixed-temperature detectors.

THERMOSTATIC CABLE

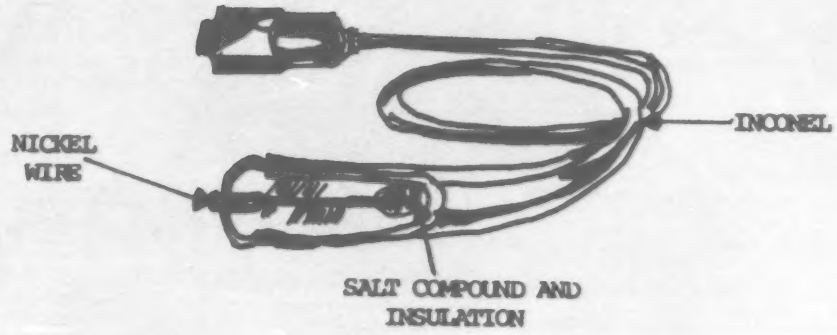


Fig. 1

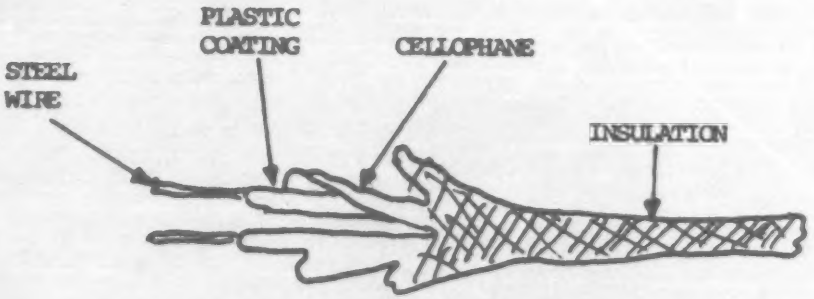


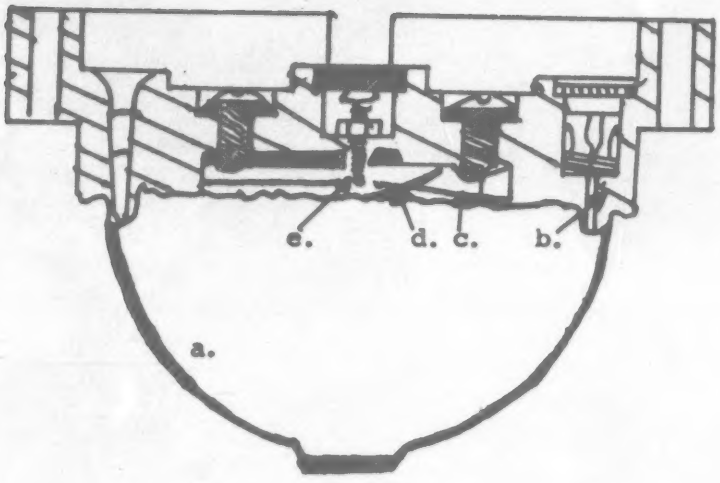
Fig. 2

Thermoplastic and chemical salt fixed-temperature detectors provide an excellent source of linear-type fire detection.

DETECTOR RATINGS

	NORMAL CEILING TEMPERATURES	TEMPERATURE RATING OF DETECTORS
ORDINARY	Less than 100 degrees F.	135 to 160 degrees F.
INTERMEDIATE	100 to 150 degrees F.	175 to 225 degrees F.
HIGH	150 to 225 degrees F.	250 to 300 degrees F.
EXTRA HIGH	225 to 300 degrees F.	325 to 360 degrees F.

RATE OF RISE TEMPERATURE DETECTOR



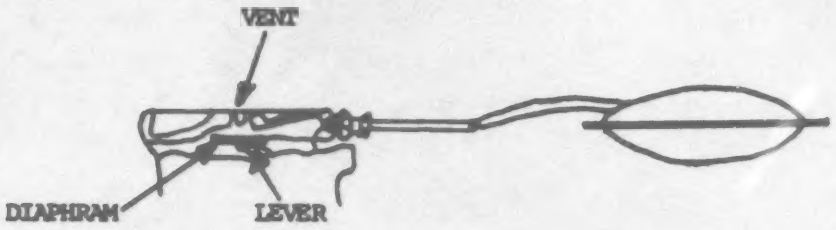
a. Air Chamber
b. Vent
c. Flexible Metal Diaphram
d. Spring
e. Adjustment Screw

A pneumatic rate-of-rise detector utilizes a pocket of expanding air to detect fire. The pocket is vented to allow the detector to adjust to moderate temperature and barometric changes.

PNEUMATIC-TUBE SYSTEM

A pneumatic-tube system can be equipped with large air chambers which increase the sensitivity of the line-type detection system.

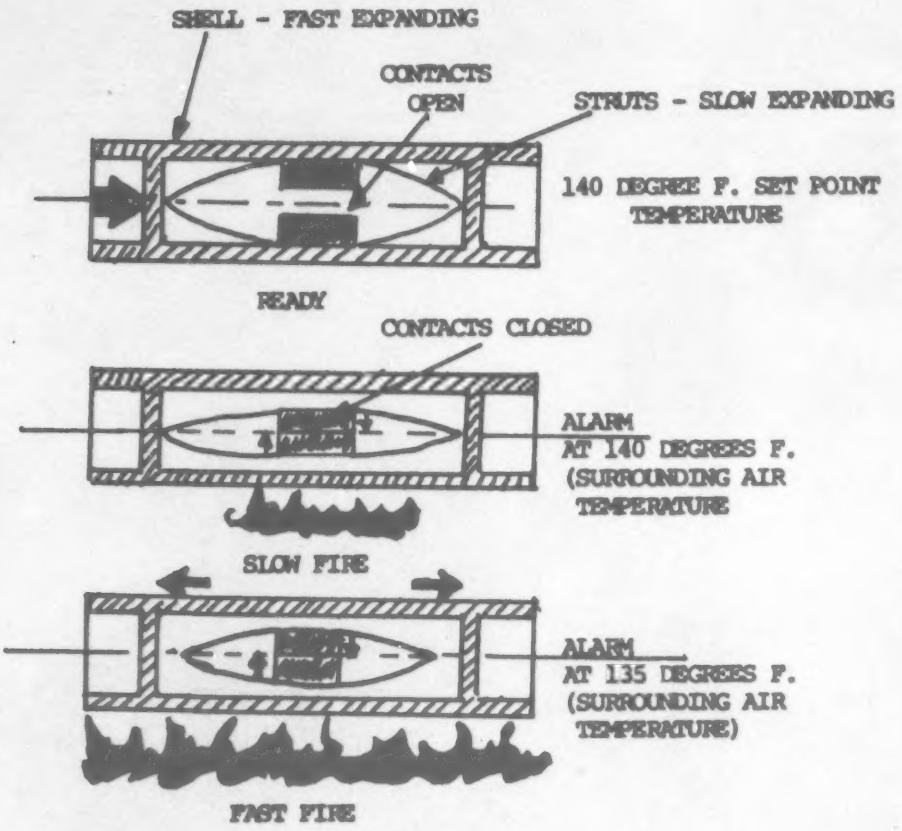
These devices are usually called HADS which stands for HEAT ACTIVATED DEVICE.



PNEUMATIC CONTROL IN SET POSITION

PNEUMATIC CONTROL IN RELEASE POSITION

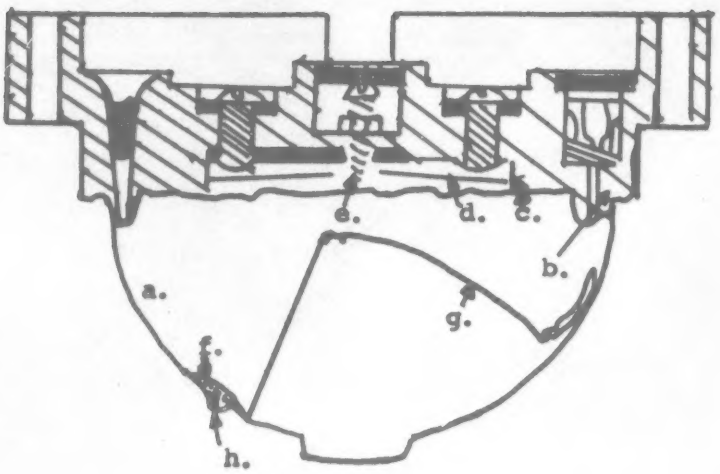
RATE-COMPENSATED DETECTOR



A heat-compensated detector uses the expansion characteristics of two different metals to produce one of the most reliable rate-of-rise detectors.

DETECTOR	SENSITIVITY	RELIABILITY	STABILITY
Fixed Temperature	Poor	Good	Good
Rate-of-Rise	Fair	Fair	Good
Rate Compensated	Fair	Good	Good
Invisible Products-of-Combustion	Good	Fair	Fair
Visible Products-of-Combustion	Good	Fair	Fair
Flame - Ultraviolet	Good	Fair	Fair
Flame - Infrared	Good	Fair	Poor

COMBINATION RATE-OF-RISE AND FIXED-TEMPERATURE DETECTOR

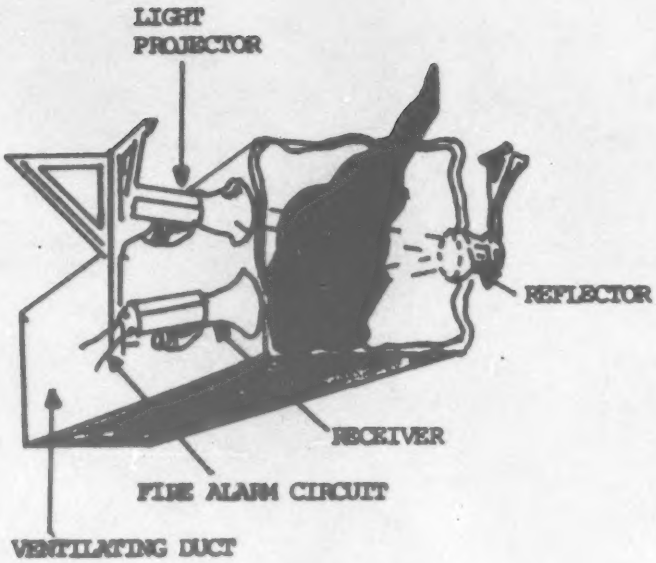


a. Air Chamber
b. Vent
c. Flexible Metal Diaphram
d. Spring
e. Adjustment Screw
f. Fusible Alloy
g. Spring
h. Indicator

A spring tension strip is soldered into a standard rate-of-rise detector to produce a combination rate-of-rise fixed-temperature detector.

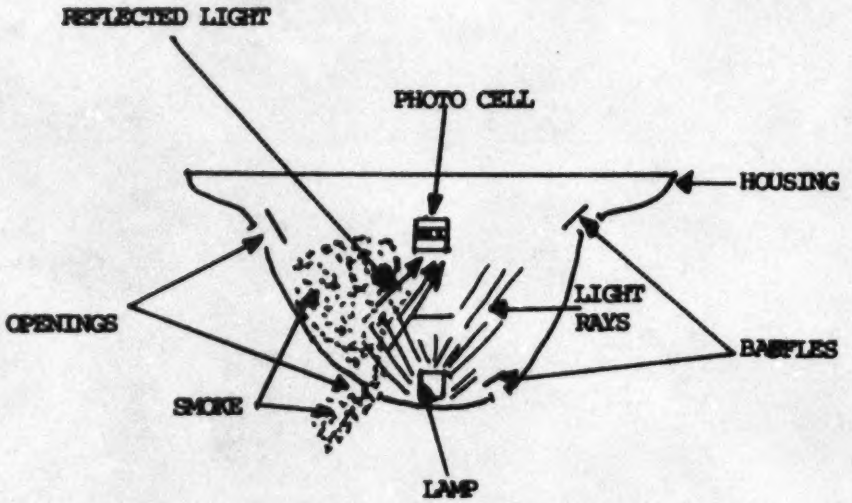
When the solder melts the strip springs against the diaphram sending an alarm.

LINE-TYPE SMOKE DETECTOR



The line-type photocell can be utilized to monitor ventilation equipment. The beam can be reflected through a mirror or prism to a receiver not in line with the light source.

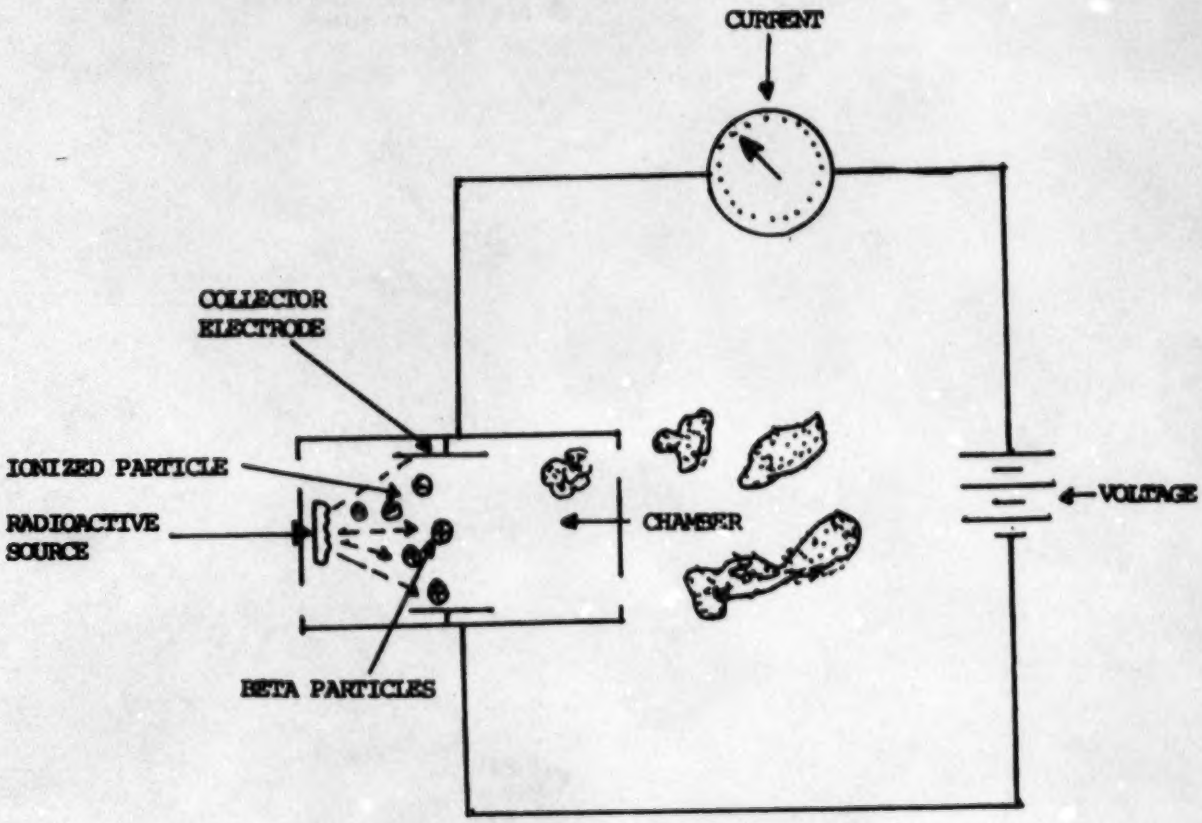
PHOTOELECTRIC SMOKE DETECTOR
SPOT-TYPE



A refractory-type photocell detector utilizes the light-scattering qualities of light instead of a direct beam to monitor for fire.

This application is used exclusively in spot-type applications.

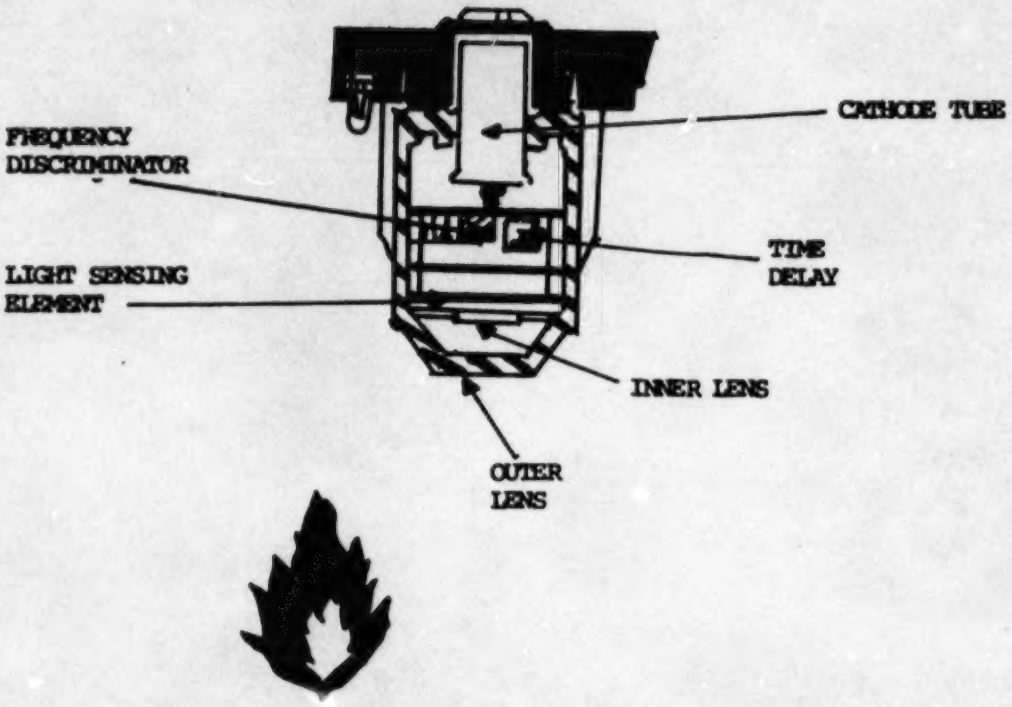
PRINCIPLE OF AN IONIZATION CHAMBER



The ionized state of smoke particles moving into the chamber neutralizes the ionizing effect of the radioactive material.

This causes the current to stop flowing and sends an alarm.

INFRARED FLAME DETECTOR



Infrared detectors detect light above 7,700 angstroms in wave length.

They are a good large-area coverage detector.